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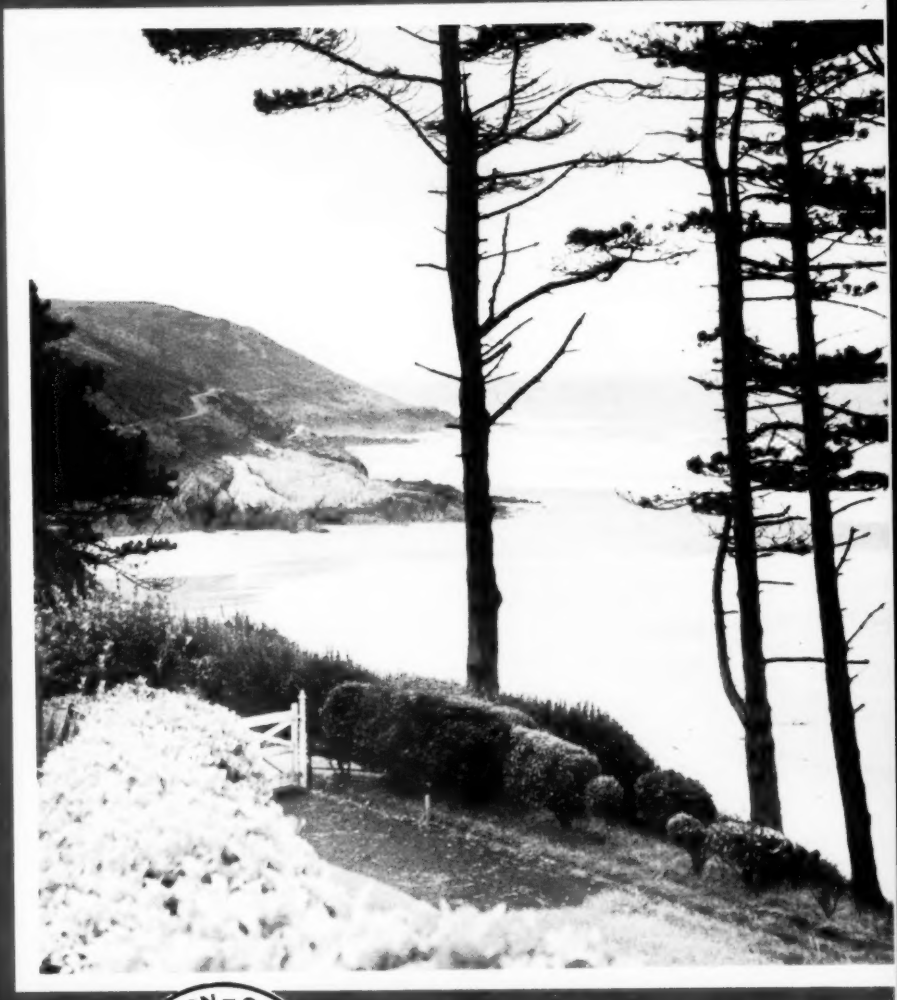

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Jan.-Feb. 1961

Vol. V, No. 5

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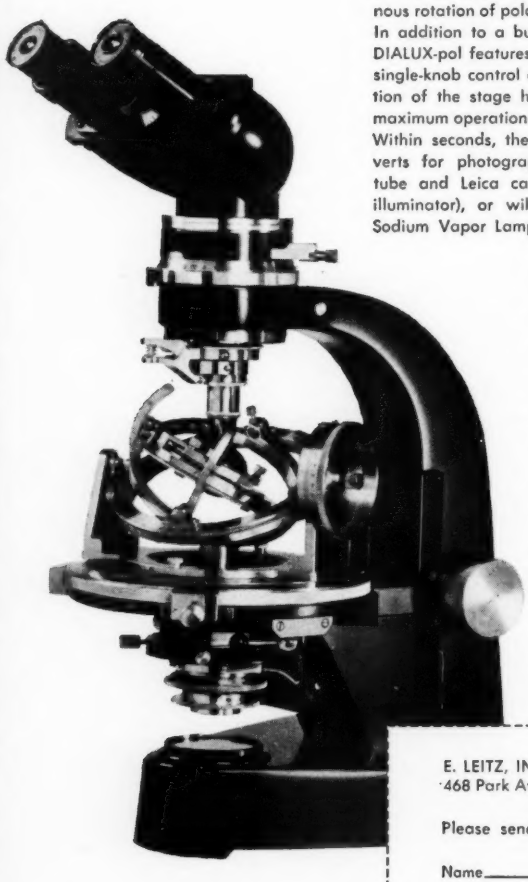

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Calendar

Cooperation of Society Secretaries in supplying meeting notices for GEOTIMES calendar is requested.

Jan. 23-26, 1961—AMER. METEOROLOGICAL SOC., Ann. meeting, joint with Inst. Aerospace Sci. and N.Y. Acad. Sci. Write: Hdqtrs.

Feb. 8-10, 1961—CANADIAN INST. OF SURV. & PHOTOGRAMMETRY, Ann. Meeting, Ottawa, Ont.

Feb. 10, 1961—12th ANN. SYMPOSIUM ON HIGHWAY GEOLOGY, University of Tennessee, Knoxville; Write: R. A. Laurence, USGS, Room 11, P. O. Bldg., Knoxville 2, Tenn.

Feb. 26-Mar. 2, 1961—AIME: Ann. Meeting, Chase and Park Plaza Hotels, St. Louis.

Feb. 27, 1961—CANADIAN SOC. OF EXPLOR. GEOPHYSICISTS, conference, "Exploration geophysics—Today and Tomorrow." Palliser Hotel, Calgary, Alta.

Mar. 5-10—ASP-ACSM: Annual Meeting, Shoreham Hotel, Washington, D. C.

Mar. 7-8, 1961—7th BIENNIAL GEOLOGICAL SYMPOSIUM, sponsored jointly by Univ. of Oklahoma School of Geology and Arkansas Geol. & Conserv. Comm., Univ. of Okla., Norman. Four technical sessions and a dinner meeting; theme, Geology of Arkoma Basin, E. Okla. and W. Ark. Write: Carl A. Moore, School of Geology, Univ. of Okla., Norman.

Mar. 21-30—AMER. CHEM. SOC., 139th Meeting, St. Louis, Mo.

Mar. 20-24—SEVENTH NUCLEAR CONGRESS, Chicago, Ill.

Mar. 24-29, 1961—NAT'L. SCIENCE TEACHERS ASSOC., 9th Ann. convention, Hotel Sherman, Chicago, Ill. Write: NSTA, 1201 16th St., N.W., Washington 6, D. C.

*Mar. 26-31, 1961—SSA & GSA, CORDILLERAN SECT.: joint meeting at San Diego State College, San Diego, Calif. Papers on 27th and 28th, field trips before and after meeting to study geology and geomorphology of the area and geology of NW Baja Calif. and on Scripps Research Vessel. Write: Baylor Brooks, Dept. Geol., San Diego State College, San Diego 15.

Mar.30-April 1, 1961—FOURTH SYMPOSIUM ON ROCK MECHANICS, at Penn State Univ. Write: Dept. of Mining, Penn. State Univ.

April 7-9, 1961—AIME: Sixth Ann. Mining, Minerals and Petroleum Conf., Anchorage, Alaska. Write: C. F. Herbert, co-chairman, 321 C Street, Anchorage, or C. E. Smith, co-chairman, Union Oil of Cal., 2805 Denali St., Anchorage.

*April 13-15, 1961—GSA: SE SECTION Ann. meeting, Andrew Johnson Hotel, Knoxville, Tenn. Sponsored by Univ. of Tenn. and Tenn. Division of Geology. Papers—2 days, field trips—1 day. Write: Harry J. Klepser, Dept. of Geology, Univ. of Tenn., Knoxville.

April 17-19—CIM: Annual General Meeting, Chateau Frontenac, Quebec City, Quebec.

April 18-21, 1961—AGU: Ann. meeting, Nat. Acad. Sci., Washington, D. C.

April 20-21, 1961—AIME: Soc. of Petrol. Eng., East Texas-Lou.-Ark., gas technology symposium, Tyler, Texas.

April 20-21, 1961—AASG: Ann. meeting, Moscow, Idaho.

April 20-22, 1961—OHIO ACAD. OF SCIENCE, 70th Ann. Meeting, Univ. of Cincinnati.

April 23-27—ACerS: 63rd Annual Meeting, Royal York Hotel, Toronto, Ontario.

April 24-25, 1961—AIME: Nevada Sect., South-West Mineral Industry Conf., in conjunction with Industrial Metals, Stardust Hotel, Las Vegas, Nev. Write: L. J. Hartzell, P. O. Box 2008, Henderson, Nevada.

*April 24-27, 1961—AAPG-SEPM: 46th Ann. Meeting, Hilton Hotel, Denver, Colo. Field trips before and after meetings to study all phases of Colorado geology. Write: Laurence Brundall, 305 E & C Bldg., Denver 2.

April 27-29, 1961—6th ANN. INST. OF LAKE SUPERIOR GEOLOGY, Port Arthur, Ont., Canada. Write: E. R. Mead, 213 Park Street, Port Arthur.

April 28, 1961—W. VA. ACAD. OF SCIENCE, Geol. and Mining Sect., Bethany College, Bethany, W. Va.

May 4-5, 1961—AIME: Soc. of Petrol. Eng., oil recovery conf., Midland, Texas.

*May 11-13, 1961—GSA: Rocky Mountain Sect., meeting at Laramie, Wyo., with 1-day field trip to study Precambrian and sedimentary rocks and geomorphology in the Laramie Basin. Write: W. R. Keefer, Box 3007, Univ. Sta., Laramie.

*May 12-14, 1961—AIME: Central New Mexico Sect., Sixth Ann. Uranium Symposium, Grants, N.M. Field trip to neighboring mines and mills.

May 25-26—AIME: Joint Meeting Rocky Mountain Petroleum Sects., Salt Lake City, Utah.

June-July, 1961—WORLD METEOROLOGICAL ORGANIZATION, Regional Assoc. III (South America), Session, 3rd, Rio de Janeiro, Brazil. Campagne Rigot, Av. de la Paix, Geneva, Switzerland.

June 17-22—INTERNAT. CONF. ON SOIL MECHANICS & FOUNDATION ENGINEERING, 5th, Paris, France. M. Buisson, Gen. Sec'y., Assoc. Francaise de Mech. des Sols et des Fondations, 31, rue Henri Rochefort, Paris 17e, France.

Aug. 21-Sept. 6 — PACIFIC SCIENCE CONGRESS, 10th, Honolulu, Hawaii. Pacific Science Assoc. Secretary General, 10th Pacif. Sci. Cong., Bishop Museum, Honolulu 7, Hawaii.

Aug. 21-Sept. 6—SPECIAL COMMITTEE ON OCEANIC RESEARCH, 5th Meeting, Honolulu. Dr. Günther Bohnecke, Secy., Bernhard-Nochstr. 78, Hamburg 4, Germany.

August—INTERNAT. COUNCIL OF SCIENTIFIC UNIONS, 9th General Assembly, London, Eng. National Academy of Sciences-National Research Council, Washington 25, D. C.

Sept. 3-8, 1961—AMER. CHEM. SOC., 140th meeting, Chicago, Ill.

Sept. 18-23—III INTERNAT. CONGRESS OF SPELEOLOGY, Vienna, with excursions before and after the meetings. Write: Generalsekretariat des 3. Internationalen Kongresses für Speläologie, Verband österreichischer Höhlenforscher, Wien II, Obere Donaustrasse 99/7/3.

Oct. 8-11, 1961—AIME: Soc. of Petr. Engrs., Fall meeting, Dallas, Texas.

*Oct. 14-18, 1961—NATIONAL CLAY CONF., Univ. of Texas, Austin. Field trip Oct. 14 to bentonite localities of Texas Gulf Coast and vermiculite field trip Oct. 15. Write: E. Joseph Weiss re program or papers and Stephen E. Clabaugh re field trips, both at Univ. of Texas.

Oct. 18-21, 1961—AAPG: Mid-Cont. Regional meeting, Amarillo, Texas.

Oct. 25-27, 1961—GULF COAST ASSOC. OF GEOL. SOC'S., meeting, San Antonio, Tex.

Nov. 2-3, 1961—AIME: Soc. of Petr. Engrs., 32nd Ann. California regional meeting, Los Angeles, Calif.

Nov. 2-4, 1961—GSA: Ann. Meeting, Cincinnati, Ohio.

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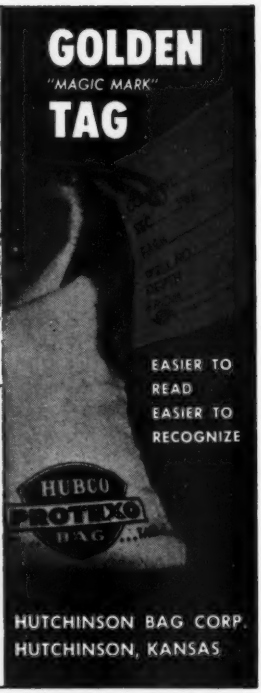

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Nov. 5-9, 1961—SEGP: 31st Ann. Internat. Meeting, Denver, Colo.

Nov. 9-10, 1961—AAPG: Pacific Coast Sect. Regional Meeting, Los Angeles, Calif.

Dec. 26-31, 1961—AAAS: Ann. Meeting, Denver, Colorado.

INTERNAT. ASSOC. OF PHYSICAL OCEANOGRAPHY, Symposium on Ocean Circulation. Prof. B. Kullenberg, Sec'y., c/o Oceanografiska Institutet, P.O. Box 1038, Göteborg 4, Sweden.

1961 SCHEDULE OF FIELD TRIPS

For additional field trips held in conjunction with meetings, see those items marked with an asterisk under meeting calendar.

Mar. 24-25—SHREVEPORT GEOL. SOC., trip to study Upper and Lower Cretaceous outcrops and Paleozoic contacts in SW Ark. and SE Okla. Write: J. D. Aimer, Box 1092, Shreveport.

April 7-8—GEOL. SOC. OF KENTUCKY, Ann. Spring Field Conf., Middlesboro, Ky., to study "Geologic features of Cumberland Gap area, Ky., Tenn., and Va." Write: T. J. Crawford, Ky. Geol. Surv., Univ. of Ky., Lexington.

April 15—ILLINOIS STATE GEOL. SURV., trip to Mississippian strata and glaciation evidences of the Sparta region, Randolph County, Ill.

May 5-7—GEOLOGIC FIELD CONF., 10th Indiana on Stratigraphy of the Silurian rocks of Northern Indiana, Indiana Geological Survey joint with Dept. of Geology, Indiana University. Hdqtrs. Spencer Hotel, Marion, Ind. Write: M. E. Biggs, Geol. Survey, Bloomington, Ind.

May 5-7—SOUTHWESTERN ASSOC. OF STUDENT SOC'S. 2nd ann. field trip to "Arbuckle Mountains and Criner Hills of Oklahoma." Chairman: Prof. J. Loyd Watkins, % Midwestern University, Wichita Falls, Tex. Guidebook.

May 6—ILLINOIS STATE GEOL. SURV., trip to study Mississippian formations and to collect geodes and fossils in the Hamilton region, Hancock County, Ill.

May 20—ILLINOIS STATE GEOL. SURV., trip to Mazon Creek and Braidwood plant fossil collecting areas, quarries and outcrops of Morris area, Grundy County, Ill.

Aug. 25-26 — FRIENDS OF THE PLEISTOCENE, Rocky Mountain Section, 7th Ann. Field Conf., Bear Lake-American Falls, Ida. Write for inf. and reservations: J. Stewart Williams, Utah State U., Logan.

Sept. 7-8—ROCKY MOUNTAIN ASSOC. OF GEOLOGISTS, field conf. to study pre-Pennsylvanian section in Salida, Monarch, Ouray, Silverton and Durango areas. Technical session in Salida night of Sept. 6. Write: Conf. chairman D. W. Bergman, 315 Colorado Bldg., Denver, Colo. Guidebook.

FIELD TRIP CALENDAR

Most of the information regarding field trips in this calendar appears through the courtesy and cooperation of the AAPG Field Trip Committee. Corrections, additions and new trip notices should be sent to George H. Fentress, Chairman, AAPG Field Trip Committee, P. O. Box 2585, Denver 1, Colo., with a carbon copy to GeoTimes Calendar, American Geological Institute, 2101 Constitution Ave., N.W., Washington 25, D. C.

This Month in GEOTIMES

Professional News Magazine

Published by **THE AMERICAN GEOLOGICAL INSTITUTE**

Robert C. Stephenson, EDITOR

Kathryn Lohman, CIRCULATION MANAGER

VOL. V, No. 5 Jan.-Feb. 1961

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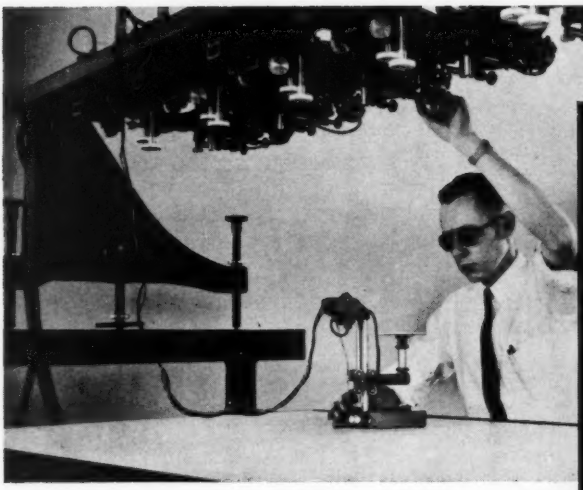

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If you feel AGI has done nothing for you, perhaps you might feel differently if you put some of your talent, energy and resources into AGI. *Whatsoever a man soweth, that shall he also reap.* LUKE 6:7.

OUR COVER

Coast of Gower, South Wales, showing typical Carboniferous Limestone scenery, 3 miles from University College, Swansea. See story page 14 (Photo by T. C. Marchant).

The AMERICAN GEOLOGICAL INSTITUTE is a non-profit professional service organization established and managed by the scientific societies in the fields of geology and geophysics in cooperation with the National Academy of Sciences-National Research Council. It is the instrument of the profession serving and advancing the welfare of the geoscientist in matters relating to education, professional responsibilities and government relations. It is an active member of the Scientific Manpower Commission. It also functions in the stimulation of public education and awareness of the earth sciences, through career literature, the scouting program and other channels of communication.

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some aspects of

THE CHILEAN EARTHQUAKES OF 1960

by JAMES N. JORDAN [1]

The swarm of earthquakes that began on May 21, 1960 and have continued to the present are unique in several ways. It is estimated that 2,000 persons were killed, about a half million persons were made homeless, and property damage totaled about $500,000,000 in Chile. The widespread damage due to the tsunami is historic. Equally impressive is the latitudinal range (37½°-51°S) of the epicenters and the tremendous energy release within a relatively short interval.

Tsunami damage occurred along the shores of South America, certain parts of North America (principally Southern California–$500,000 damage), the Hawaiian Islands (56 deaths and $75 million damage), New Zealand, the Philippine Islands (19 deaths and 13 missing), the Japanese Islands ($50 million damage), and other areas in and around the perimeter of the Pacific Ocean.

The Seismic Sea Wave Warning System, a responsibility of the Coast and Geodetic Survey, that makes use of seismograph and tide station data to warn given areas of impending destructive tsunamis, functioned well. The inadequacy of a warning service in many of the affected countries and other factors accounted for the high loss of life.

The distance traveled by the seismic-generated water wave was unusual and may have been due to the particular sequence of shocks which occurred within seconds of the major shock. Table 1 shows the times and energy release of the shocks.

The epicenters ranged from 37 degrees to 51 degrees south latitude with the majority of the larger shocks being located between 37 and 41 degrees. Major property damage occurred in cultured areas in or near the Coast Ranges within the latter-mentioned latitudes.

During an average year about twenty earthquakes would be classified by seismologists as being of Magnitude VII or greater. Within two days, five of the shocks in Chile fell in this category. Preliminary locations have been determined for seventy of the several hundred shocks (see Fig. 1), and the majority of these had magnitudes greater than 6. It is expected that more epicenter determinations will be made as the seismograms of nearby stations become available.

From the present evidence it appears that the depths of the larger and more destructive shocks vary between 40 and 60 kilometers. The depth factor undoubtedly accounts for the diminution of terrain effects. Comparing the terrain effects of equivalent or near equivalent shocks in the western United States with those in Chile, one finds that the surface effects are much more evident in the U. S. Apparently, the shallow depths of western North America shocks account for the more spectacular effects. The Hebgen Lake shocks of August 1959 revealed a vertical displacement of 19 feet, and past horizontal movements as great as 21 feet along the San Andreas fault are well documented in the literature. The nature of the surface effects associated with the Chilean series will be mentioned later.

The NSF-EERI investigating group arrived in Santiago about three weeks after the catastrophe and with representatives of the various Chilean agencies proceeded to the epicentral area. The principal areas visited were Concepcion, Temuco, Valdivia, Osorno, Puerto Montt, and intermediate points. There were other groups in Chile at the time, notably, the Japanese team of Drs. Ryutaro Takahasi, Hajime Umemura and Takeo Watanabe, a French team, and an Italian vulcanologist. The Japanese brought three complete, three-component seismograph stations which were installed

[1] JAMES N. JORDAN, of the U. S. Coast and Geodetic Survey, participated in the National Science Foundation — Earthquake Engineering Research Institute investigations in Chile. The other members of the group were DR. RAY CLOUGH, University of California at Berkeley; MR. C. MARTIN DUKE, UCLA; DR. K. KANAI, Fulbright Fellows at UCLA from Tokyo University; MR. KARL STEINBRUGGE, Pacific Fire Rating Bureau.

A military band played lively morale-building music throughout the day in this bandstand on the plaza in Valdivia. Note twisted steel supports and toppled statue.

A damaged masonry-brick building near the central plaza in Valdivia.

These twisted steel beams had been removed from damaged structures near the Calle Calle River which appears in the background. The park area and street adjacent to the river were flooded.

at Concepcion, Temuco and Osorno for precise epicenter determinations, strain release, and ground motion studies. The results of these studies would be necessary for the development of an effective building code, the chief concern of the Chilean authorities.

Damage Assessment

Upon entering the epicentral area, it was readily seen that tremendous damage had occurred in the aforementioned cities. This damage will be treated comprehensively in the final NSF-EERI report, but it is worthwhile to summarize the salient facts (Table 2).

These preliminary sampling figures provided by the Corporacion de Viviendas relate to residential property where survey figures show about 5 persons per household. Damage to non-residential property would be equal to or greater than these figures. Estimates of damage in Valdivia seem to be low, however, the relatively high percentage of damage to plants in this industrial area would substantially augment the figures in Table 2.

The aid provided by foreign nations was tremendous and improved living conditions in the damaged areas. Many people, principally elderly and very young, were evacuated to cities in the north. Large landslides upstream from Valdivia dammed Lake Rinihue waters 30 meters above the normal level. Because of these menacing flood conditions and the extreme damage wrought directly by the shocks, Valdivia was about 70% evacuated.

Many Observers

In evidence all over the place were newsmen representing various media as well as professors and individuals from many educational and official institutions. Although the prime function of the trip was to observe and collate technical data, the group participated in a taped radio interview. Dr. Luis Aguirre, of the I.I.G. (Institute of Geological Investigations), acted as bilingual moderator, with each member of the commission participating.

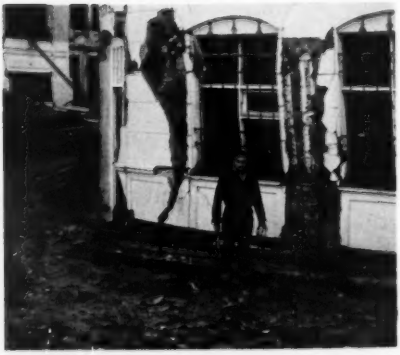
The damage in Valdivia, as well as in some other locales, was dramatically related to the soil conditions. Along the shores of the Rio Calle Calle and in the Arroyo Antiquo, an old meander of this river which is now an urban area, there was a high incidence of damage. General slumping of the banks along these features was notable. With few exceptions, the more spectacular structural damage decreased abruptly with distance from the two above-mentioned zones.

Date	Time	Location	Intensity
May 21	10-02-50	37½ S, 73½ W	Mag 7½ - 7½ (Berk)
21	10-53-51	37½ S, 72½ W	
21	12-21-16	37½ S, 73 W	
21	12-59-58	37½ S, 72½ W	
21	13-59-17	37½ S, 72½ W	
21	14-31-55	37½ S, 72½ W	
21	15-08-45	37½ S, 73 W	
21	19-06-21	Chile (Near 37 South)	
22	03-46-22	37½ S, 73 W	
22	06-01-36	38 S, 73½ W	
22	08-10-53	37½ S, 73 W	
22	10-30-39	38 S, 73½ W	Mag 6½ (Pas) 6½ (Berk)
22	10-32-43	37½ S, 73 W	7½ - 7½ (Pas) 7 (Berk)
22	12-16-43	38 S, 73 W	
22	18-55-57	38 S, 73½ W	7π (Berk)
22	19-10-47	38 S, 73½ W	7½ - 7π (Berk)
22	19-11-20	38 S, 73½ W	8½ - 8½ (Pas) 8½ (Berk)
22	23-29-18	39½ S, 72 W	
23	00-25-44	38½ S, 75 W	
23	00-51-12	37½ S, 72 W	
23	01-34-53	39½ S, 74 W	
23	02-46-30	41½ S, 73½ W	
23	02-56-17	43 S, 75½ W	
23	05-13-35	38 S, 73½ W	
23	07-09-17	48 S, 77 W	
23	08-13-15	40½ S, 75½ W	
23	09-52-20	37½ S, 73 W	
23	10-37-59	43½ S, 73½ W	
23	14-01-50	Near Coast of Chile	
24	20-32-43	50½ S, 74 W	
25	04-44-06	Southern Chile	
25	08-34-33	45 S, 76 W	Mag 6π (Pas) 6½-½ (Berk)
25	19-21-48	40 S, 75½ W	
27	03-17-21	41 S, 76 W	
27	20-49-12	Northern Chile-Bolivia Border	
27	23-06-55	45 S, 77 W	
28	03-05-53	39½ S, 74½ W	
28	11-05-40	38 S, 73 W	
29	07-39-29	38 S, 72½ W	Mag 6½
29	08-34-20	37½ S, 73 W	
29	14-05-25	37½ S, 73 W	
29	21-23-54	Near Coast of Southern Chile	
31	02-40-01	39½ S, 75 W	Mag 6½

Los Animas bridge at Valdivia was heavily damaged. The abutment gave way due to slumping of the river bank.

Urban Areas	Population (thousands)	% Homeless due to irreparable damage	% Homeless due to reparable damage	Estimated ground accelerations (% of gravity)
Concepcion	412.0	8.5	52	15-20
Valdivia	60.0	16.0	16	25-30
Osorno	63.7	7.0	19	15-20
Puerto Montt	38.0	26.0	-	30-35

Table 2. Tabular summary of damage in the principal affected areas.



Typical damage to brick and masonry structures in the area near the river.

Effects on Terrain

The first strong impression of terrain effects gained from field inspections was that there was general subsidence in the Valdivia area. Subsequent travel to the south showed that this regional subsidence was between 1 and 1.5 meters. Then, one should ask—were there any fault scarps showing this order of faulting? There were none noted! A small scarplet about twenty-five kilometers west of Osorno and faults and subsidence noted during a flight west of Puerto Montt, give some idea of the primary Coast Range structure that may be associated with the shocks.

From Figure 2, one may note the areas of subsidence near Valdivia and west of Puerto Montt. In the former the eastern side of the fault went down, whereas in the latter case the area west of the fault subsided. It was fortunate that these estuarine positions made it easier to document the movements. The topographic drop-off of the Coast Ranges to the south suggests that previous deformational forces have continued to the present. From this same figure one may note the lineation of land-

slides in the Andes Mountain which follow closely a similar lineation of volcanoes. Puyehue, the only volcano reactivated by the shocks, falls along this line. Ash blew out for several days and spread over vast areas in Chile and Argentina. Active lava flows also have been reported.

To the south, the landslides terminate, as reported by workers in the area, at the junction of this aforementioned line of volcanoes and a southwest trending group that is oriented toward the south of Lake Llanquihue and the Maullin Valley. This fault projection, as may be seen, closely approaches Puerto Montt and may account for the generally high accelerations in the vicinity. This latter fact is more understandable when one considers that Osorno is closer to what is viewed as the major structure (Coast Ranges–Central Valley Fault Zone) although it apparently experienced lower accelerations. Therefore, it is believed reasonable to suppose that a Central Valley fault zone runs near Puerto Montt. Dr. Lomnitz, using gravity results, has detailed a similar Central Valley fault near Chillan with a throw of two kilometers. Deep sediments and internal structure within the Central Valley may have economic implications.

If one may view the Coast Ranges instead of the Andes as the more closely associated structure, then the enormous earth and rock slides reported in the Andean foothills become an interesting enigma since many appear to occur in competent rock. It is generally recognized that in Cretaceous time there were two major geosynclines–the Andean and the Magellan. The southernmost part of the Andean geosyncline was to the north of Concepcion and the eastern edge corresponded to present eastern limits of the Andes Mountains. The basin was open to the north with the ill-defined western limits well to the west of the present shoreline. The major axis of this structure apparently ran northwesterly from the present Andean lineation. The Magellan ran from Tierra del Fuego slightly across the present Andes, possibly communicating with the Andean geosyncline to the north.

The epicentral area of major shocks which is relatively non-seismic seems to fall in this ill-defined border zone of the two geosynclines. It has been reported that this area was emergent during much of the earlier stages of Cretaceous orogeny. The present surface rocks in the Coast Ranges of the region are Pre-Cambrian in age. Further studies of these shocks may shed additional light on the geological structure of the section.

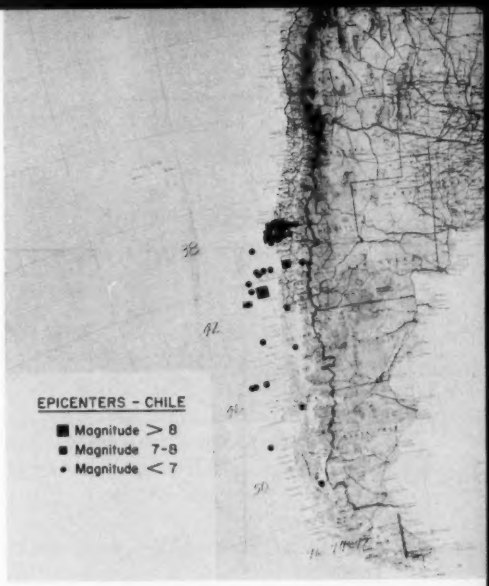


Figure 1. Preliminary locations of epicenters and magnitude of shocks in Chile during the interval May 21-31, 1960.

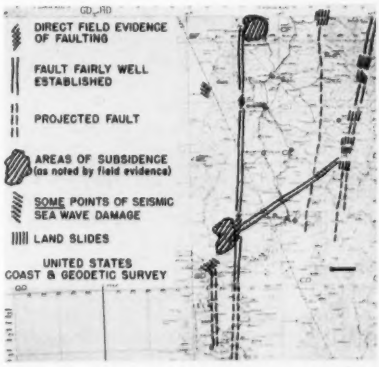

DIRECT FIELD EVIDENCE OF FAULTING
FAULT FAIRLY WELL ESTABLISHED
PROJECTED FAULT
AREAS OF SUBSIDENCE (as noted by field evidence)
SOME POINTS OF SEISMIC SEA WAVE DAMAGE
LAND SLIDES
UNITED STATES COAST & GEODETIC SURVEY

Figure 2. Terrain features in Chile resulting from the earthquake shocks.

In that precise levelling and triangulation surveys have been made of the area it has been strongly recommended by many groups that repeat observations would be of inestimable scientific value. The ICA-USGS geologists and Chilean geologists, who aided substantially the efforts of the NSF-EERI group, have continued studies in the area. These and other groups' studies will undoubtedly result in a more cogent understanding of the nature of some of the deformation forces active within the earth.

VIGIL for DISASTER[1]

by K. J. MURATA[2]

At 11 p.m. of May 22, 1960, members of the U. S. Geological Survey Hawaiian Volcano Observatory stationed themselves on the shore of Hilo Bay at the Wailuku River bridge to wait for the possible arrival of a strong tsunami from Chile. Fourteen hours before, the seismographs at the observatory had recorded a Chilean earthquake whose magnitude of 8¼ definitely raised the possibility that a major tsunami had been generated. What the size of the waves would be in Hilo Bay was conjectural.

The Wailuku River bridge on the north side of Hilo offered two advantages as an observation site: first, the piers of the bridge when appropriately marked could be used as a scale to measure the height of the water, and second, the road leading to the north allowed easy retreat to high ground, if necessary. The group at the bridge consisted of Wayne Ault, Jerry Eaton, Don Richter, and the writer, of the Geological Survey, accompanied by William Dunmire and Robert Haugen of the National Park Service.

The vigil for waves originating so far across the ocean could not help but sharply emphasize the strategic and, and at the same time, vulnerable position of Hawaii with respect to seismic phenomena in the entire circum-Pacific region. Its central location makes Hawaii a strategic place to study the seismology of the whole Pacific Basin. By the same token, it is vulnerable to tsunamis from all sides.

As the seconds ticked off toward the zero hour of midnight, conversation revolved around the meager information that was available to judge what might be expected. The disastrous tsunami of 1946 and the smaller ones of 1952 and 1957 had originated either in the Aleutians or Kamchatka. Tsunamis of Chilean origin had struck Hilo earlier, in 1837, 1877, and 1906. Over the years, dozens of small tsunamis had reached Hawaii from different directions without causing any damage. In fact, Harold Krivoy of the Geological Survey had just the day before discovered that a small tsunami, generated by one of the Chilean foreshocks with magnitude 7¾, had entered Hilo Bay. With an amplitude of only 6 inches the tsunami was too small to be noticed by people who happened to be at water's edge at the time, but it was clearly recorded on the tide gage at the wharf.

Magnitude is but one of several factors that determine whether an earthquake does or does not generate a strong tsunami. The depth of the shock, type and lateral extent of crustal displacement, and the nature of coupling between the involved crust and ocean water also are important elements in tsunami generation.

Also at the receiving end, several factors influence the height of the invading waves; among these the configuration of the coastline, the bottom topography offshore, and the direction of incidence of the tsunami are most easily recognized. From all past indications Hilo Bay was peculiarly susceptible to the development of strong waves regardless of the direction of incidence.

Meanwhile, the awaited tsunami was approaching Hawaii at a speed of almost 500 miles per hour.

After the destruction of a large part of Hilo by the 1946 tsunami, with a loss of 96 lives in Hilo alone, a tsunami-warning service for the Hawaiian Islands was established by the U. S. Coast and Geodetic Survey, with headquarters at Honolulu on the Island of Oahu. The Honolulu station serves as a center for receiving notices of all major earthquakes of circum-Pacific origin from cooperating seismological ob-

[1] Publication authorized by the Director, U. S. Geological Survey.

[2] K. J. MURATA, U. S. Geological Survey, Washington, D. C.

servatories. It also maintains direct communications with several tide gage stations scattered around the Pacific. The detection of tsunamis potentially dangerous to Hawaii thus is based on rapid acquisition and assessment of seismological and tide-gage data.

The latest reports on the local radio told of a 1¾ foot wave on Christmas Island and a 3½ foot wave on Tahiti. A state-wide alert had been in force since 8:30 p.m. Little did the observers on Wailuku bridge realize that there were many people in Hilo who did not understand the significance of the alert and had not moved to high ground. There was no inkling that the fate of 61 persons in Hilo had already been sealed the moment the tsunami was generated 6,700 miles away.

At 12:07 a.m., May 23rd, a rapid, momentary, 3-foot rise in the level of the Bay at the bridge gave clear indication that the first wave had arrived. Thirty minutes later a 9-foot rise marked the arrival of the second wave. There was no wave in the ordinary sense but rather a surging influx of water that rose rapidly far up into the Wailuku River estuary. Then followed a dramatic withdrawal of water that lowered the level 7 feet below normal and exposed a great expanse of the Bay floor. At 1.05 a.m., the observers began to hear a roar offshore and soon their flashlights probing the darkness revealed a 20-foot wall of water moving toward the City. Without further ado they ran off the bridge and up the highway.

Brilliant flashes of greenish light along the waterfront street and from across the Bay indicated that power lines and the power station were being knocked out, and the City was immediately plunged into darkness. The crashing of plate glass windows and a general confusion of sounds generated by collapse of buildings were all that was heard from the business district near the bridge. The residential area that was overwhelmed was at the other end of the City so the observing party did not hear the screams of people caught in the wreckage or pulled into the Bay by the withdrawing wave. The agony of Hilo was concealed in the darkness.

The wave charged through the City with incredible force, demolishing about half the business district and obliterating Waiakea town, an older part of Hilo crammed with shops and homes. Basaltic boulders weighing as much as 10 tons were plucked from the stone embankment of the Bay and moved inland for a distance of more than 300 feet. Autos were swept up and scattered helter-skelter; some were wrapped around coconut trees, many others were dumped into a mid-city canal along with assorted houses and debris of all kind. Many substantial buildings lining the water-front street disintegrated under the impact of the wave and disappeared completely.

Tsunami damage at Hilo, Hawaii, photos courtesy of Lt. Anderson, Hawaiian National Guard.

Tsunami damage at Hilo, Hawaii, photos courtesy of Lt. Anderson, Hawaiian National Guard.

The watchers moved back on the bridge as soon as the main wave began to withdraw and measured several more oscillations of the water level. The periods were now shorter and more erratic as reflected waves moved about in the Bay and as the disturbed water began to develop strong seiches.

The tsunami waves meanwhile continued to fan out across the Pacific. On shores beyond Hawaii, others were waiting apprehensively for a possible disaster.

Neuadd Gilbertson, men's residence hall at the University College of Swansea, was formerly known as Clyne Castle. The participants in the Institute will be quartered in this attractive hall which is situated in a woodland area overlooking Swansea Bay.

AGI sponsors

INTERNATIONAL FIELD INSTITUTE

for

College and University Geology Teachers

GREAT BRITAIN
SUMMER 1961

Classic features of the geology of the British Isles will be studied in the field during the summer of 1961 by a selected group of American college and university geology teachers in an International Field Institute sponsored by the American Geological Institute under a grant from the National Science Foundation. The directors of the program will be Professor F. H. T. Rhodes of the University of Wales at Swansea and Professor Paul R. Shaffer of the University of Illinois, assisted by a group of British geological scientists. This program has been developed under the guidance of the AGI Education Committee, C. J. Roy, Chairman.

The International Field Institute for College and University Geology Teachers will provide an unprecedented opportunity for a selected cross-section of geology teachers to study together in areas of classic geologic significance under the leadership of recognized scientists who are identified with research activities in these areas. The institute participants will gain first-hand knowledge of these classic areas in the field. Through study of the literature and discussions led by the British scientists the geology teachers will become familiar with the emergence of fundamental concepts and the evolution of geologic thinking which have resulted from continuing research studies of these classic areas over the years. The group also will have the opportunity to visit important academic institutions, research organizations and museums of geology. Opportunities to discuss teaching methods, and to acquire new teaching and research literature and collections should be significant benefits to the participants.

The participants in the International Field Institute should gain new and broadened perspective in their teaching and research as a result of this experience. The personal contact with the British leaders in their own research environs should have a significant and enduring impact on the future effectiveness of the participating geologists. The program should result in less provincialism in the teaching of geology in this country. The stimulation and the new breadth of knowledge gained by the participating teachers will naturally be shared with other teachers and can be expected to benefit students who have the opportunity to study under them in future years. The results of the program should have widening and lasting influence.

It is anticipated that if this initial program is successful, international institutes will be planned in future years in other areas of classic geologic interest.

Classic Geological Areas

The participants will rendezvous in New York and travel as a group by air to London. After a brief stopover in London the group will go to Neuadd Gilbertson, a resi-

Frank H. T. Rhodes Director of the institute in Great Britain is professor and head of the geology department at University College of Swansea, University of Wales.

Paul R. Shaffer Director of the institute in the United States is professor of geology at the the University of Illinois.

Cliffs of Lower Jurassic strata Nash Point, Glamorgan, South Wales. (photo by B. J. Bluck).

Giant's Causeway, Antrim, Northern Ireland, showing Tertiary columnar basalts (photo by F. H. T. Rhodes).

Sicar Point, Berwickshire, Scotland "Hutton's unconformity," showing gently dipping Old Red Sandstone on vertical Silurian strata (photo by C. Y. Craig).

dence hall of the University College of Swansea overlooking Swansea Bay, where they will be quartered during the orientation period.

The orientation sessions will be conducted in the Geology Department of the University College of Swansea. The department is one of the most modern and best equipped in Great Britain. It is situated on one of the more beautiful parts of the Welsh Coast, at a distance of 200 yards from the sea.

During the orientation period there will be several one-day excursions to study the broad spectrum of geology which can be seen in nearby areas of South Wales. Type sections of Cambrian, Ordovician, Silurian and Carboniferous rocks lie within easy reach of Swansea and there are excellent exposures of Triassic and Jurassic rocks. The area is also noted for its outstanding Pleistocene glacial features. The dominant structural feature in South Wales is the Coalfield, an elongated basin of Carboniferous rocks, which extends from Glamorgan westwards into Pembrokeshire. To the south of this major Armorican downfold the Carboniferous and Devonian rocks are more intensely folded in the three southern peninsulas of South Pembrokeshire, Gower and the Vale of Glamorgan, while in the latter areas there is an unconformable cover of Mesozoic deposits. The Caledonoid trend of the older rocks in the north-west of the area contrasts strongly with the essentially east-west Armorican structures in the south.

The Welsh Borderland is the area in which the succession of British Lower Paleozoic rocks was first established. It is the area of the Silures and the Ordovices. It was intensively studied by such pioneer workers as Murchison, as well as by a host of subsequent distinguished geologists. In very few areas is there such an opportunity to study rocks of so wide a time-range, which display such striking local lithological and faunal variations. There are complete successions of strata ranging from Cambrian to Triassic in age. Although these include ten different unconformities and contain superb examples of facies changes, the successions are remarkably complete, and most are richly fossiliferous. This area provides excellent examples of the relationships between contemporary tectonic movement and sedimentation, and also provides an opportunity to study features of regional tectonics, relationship between shelf and basin sedimentation, various types of intrusive and extrusive igneous activity, and of Pleistocene glaciation.

North Wales (Cambria) is one of the most mountainous areas in Britain and the object of the excursion to this area is to study the stratigraphy of the Cambrian strata in this type area and the stratigraphy and petrology of the Ordovician rocks. These include great thicknesses of extrusive rocks showing considerable diversity. Close attention will also be paid to the Precambrian, intrusive igneous rocks, regional metamorphism and the complex tectonic relationships.

Many important geological principles were first established in Scotland, and the country contains areas made classic by the writings of such pioneers as Hutton, Lyell and Lapworth. A general geological tour of Scotland will be made, including visits to the Scottish Highlands. There will be opportunities to study parts of the metamorphosed Caledonian belt, the Border thrust zone, and the Caledonian foreland, as well as the Devonian and Tertiary ring-complexes. In the Midland Valley of Scotland attention will be directed towards the intrusions, volcanic necks, and lavas of this sub-alkaline Carboniferous igneous province, as well as to Carboniferous and Old Red Sandstone stratigraphy. In the southern uplands of Scotland the non-metamorphosed Lower Paleozoic strata of the Caledonian fold belt will be studied, including the graptolitic and shelly facies. In all parts of Scotland glacial phenomena are strikingly displayed.

Northern Ireland contains geological features which are famous the world over. These include the Tertiary plateau basalts (the Giant's Causeway), various glacial phenomena, and a great variety of igneous and metamorphic rocks. The excursion will include the study of the plateau basalts, the underlying Cretaceous, Triassic, Carboniferous and Devonian strata, and the study of Tertiary central complexes of Carlingford, Newry and the Mournes.

CLOSING DATE FOR APPLICATIONS

February 10, 1961

Application forms must be completed and mailed on or before February 10, 1961

to: PROF. PAUL R. SHAFFER
AGI International Field Institute—1961
c/o Department of Geology
University of Illinois
Urbana, Illinois

The roster of participants chosen by the Selection Committee will be announced not later than March 15, 1961.

There will also be detailed field studies of Lower Paleozoic strata.

The science of stratigraphy was established by William Smith in the Mesozoic strata of Southern England. These strata are best exposed in the area covered by this excursion. Almost all the sections that will be studied are coastal sections and these include virtually continuous exposures in rocks of Jurassic, Cretaceous and Tertiary age. The rocks are richly fossiliferous. Particular attention will be devoted to Mesozoic stratigraphy, paleontology and sedimentology and a study will be made of coastal geomorphology. The area includes some striking tectonic features and these will be examined in cliff sections.

At the close of the formal institute program there will be a few days which may be used at the discretion of the individual participants.

Institute Leaders

DIRECTORS

Frank H. T. Rhodes, *Professor of Geology and Head of the Department, University College of Swansea, University of Wales.*

Paul R. Shaffer, *Professor of Geology, University of Illinois.*

PARTICIPATING FIELD LEADERS

J. G. C. Anderson, *Professor and Head, Department of Geology, University of Cardiff.*

T. R. Owen, *Senior Lecturer in Geology, University College, Swansea.*

W. S. Pitcher, *Reader in Geology, King's College, University of London.*

R. M. Shackleton, *Professor of Geology and Head of Department, University of Liverpool.*

P. C. Sylvester-Bradley, *Professor and Head of the Department of Geology, University of Leicester.*

Alwyn Williams, *Professor and Head of the Department of Geology, Queen's University, Belfast*

Selection of Participants

A Selection Committee will be appointed by the AGI Executive Committee based on recommendations of the AGI Education Committee and the Executive Committee of the National Association of Geology Teachers. This Selection Committee will screen the applicants and choose approximately 20 geology teachers to be invited to participate in the International Field Institute. A number of alternates will also be named.

General view of Snowden, North Wales, showing Precambrian in foreground, Cambrian slates middle distance and Ordovician volcanics in background. Deeply glaciated Pass of Llanberris on left. (Photo by V. G. Walmsley)

Factors governing the selection will include age, background, teaching and research record and appraisal of expressed desire to participate in the program. Consideration will be given to geographic distribution of participants selected. A distribution of participants will be sought among teachers from small departments and large departments.

Financial Provisions

The American Geological Institute will provide round trip transportation by scheduled air line from home to London and return for each participant. Group travel in the British Isles will be provided at no additional cost to the participant. Each participant also will be provided a subsistence allowance of $10 per day for the eight week period. It is estimated that this allowance will be ample for meal and lodging expenses.

In this institute no stipend will be paid to participants in addition to the abovementioned allowances for travel and subsistence, nor will there be living allowances paid for dependents of the participants. No dependents of participants will be permitted to attend the Institute.

Eligibility for Participation

Application forms have been mailed with copies of this announcement to all known departments of geological science in four-year institutions in the United States. Applications will be accepted from teachers in these departments. Inquiries and requests for additional application forms may be addressed to *Professor Paul R. Shaffer, AGI International Field Institute-Summer 1961, c/o Department of Geology, University of Illinois, Urbana, Illinois.*

NSF Supports Lab. Development

The National Science Foundation announces that March 1, 1961 is the next closing date for receipt of proposals in the Graduate Laboratory Development Program. Proposals received after March 1 will be reviewed following the next closing date, September 1, 1961. This program requires at least 50 percent participation by the institution with funds derived from non-Federal sources.

Purpose of the grants is to aid institutions of higher education in modernizing, renovating, or expanding graduate-level basic research laboratories used by staff members and graduate students. Only those departments having an on-going graduate training program leading to the doctoral degree in science at the time of proposal submission are eligible at present.

Proposals, as well as requests for additional information, should be addressed to: *Office of Institutional Programs, National Science Foundation, Washington 25, D. C.*

A PALEONTOLOGICAL FORUM

The pace in paleontology, as, indeed, in all the sciences, is quickening dramatically. Many specialties, drawn along taxonomic, stratigraphic, geographic, and other lines, have appeared and have tended to diverge so far from each other that it is difficult to discern the mainstream of the science. Inevitably, communication among paleontologists has become very difficult. In recent years, revitalization of interest in biological principles of organic evolution and ecology provides common grounds for discussion of problems of mutual interest by paleontologists of all persuasions. Broad principles are increasingly subjects of debate at society meetings.

The function of most paleontological organizations is to provide facilities at various levels of specialization for intellectual stimulation and the exchange of knowledge. The society with the broadest basis for fulfilling this function is The Paleontological Society. It is one of the oldest in the world, and it is dedicated to the advancement of all branches of paleontology. Founded in 1908, with 34 charter members, it has grown to nearly 1000 members and has always included a representative cross-section of the whole science.

The Paleontological Society is now engaged in a drive to bring into its membership all persons in North America, and many from other continents, with strong interests in paleontology, including amateurs and students. This is one of the ways in which communication among paleontologists may be improved. Applications may be obtained from Society members or from the *Secretary, H. B. Whittington, M.C.Z., Harvard University, Cambridge 38, Massachusetts.*

New Manpower Data Available From 1960 NSF Register

The National Science Foundation released in December 1960 a preliminary report on scientific manpower based on 117,000 questionnaires received by the National Register of Scientific & Technical Personnel in 1960 prior to July 1. The report, Scientific Manpower Bulletin No. 12, *1960 Salaries and Characteristics of Scientists in the National Register of Scientific and Technical Personnel* summarizes the preliminary data in nine tables the titles of which are:

1. Employment status of scientists, by field, 1960
2. Salary distribution of scientists, by field, 1960
3. Distribution of 1959 gross professional income of scientists, by field
4. Median 1960 salary rates and median 1959 gross professional income reported by scientists
5. Number of scientists, by field and highest degree, 1960
6. Number of scientists, by field and age groups, 1960
7. Number of scientists, by field and years of professional experience, 1960
8. Number of scientists, by field and type of employer, 1960
9. Number of scientists, by field and principal work activity, 1960

The AGI serves as the gathering agency for the Earth Sciences in cooperation with the National Science Foundation. The Earth Science data included in this preliminary report were based on an analysis of 9,752 earth science questionnaires. An article on the earth science data selected from this preliminary report will be published in an early issue of GeoTimes.

Copies of the NSF Scientific Manpower Report 12 may be obtained free on request addressed to the *American Geological Institute, 2101 Constitution Avenue, N. W., Washington 25, D. C.*

Behind An Unmarked Door

The methodical beat of the business world fades to a swift walking rhythm as two men slip from the modern interior of 222 Loyola Avenue, New Orleans. You follow, careful not to be seen. Out of the night a melody quivers, riding on a trumpet's wail, and you are in the French Quarter where Jazz is King.

The mystery men move quickly down Bourbon Street, past endless Jazz-filled bars into narrow Governor Nicholls Street, two blocks from the dark river front. You hide beneath the lacy iron of a balcony as they enter an unmarked door. In a nearby block, a siren's wail shatters a clarinet caper.

You know the men. They are Geologists Fulton S. Gantt and Jules B. Sachs. But what drew them from their functional offices in Gulf's New Orleans Production District to this den in the heart of the homeland of Jazz? You trail them through the unmarked door . . . and meet the strains of Beethoven's Sixth!

This surprising island of classical music in the wild sea of Dixieland tempo is a remote control station for WRCM-FM. It's the home of the Classical Music Society of New Orleans. Gantt is president, Sachs the vice president and programming director. Unabashed at being discovered, they reveal a superb broadcasting setup and a growing record library and add, *"from here we send out the world's finest music."*

Founded four years ago by a few varied professional persons united by a common love for the musical classics, the Society offers fine programming four hours nightly except Sunday to Metropolitan New Orleans. Friday is opera night. The Supreme Broadcasting Company, owners of Station WRCM, gives free broadcasting time. A Society member makes available the improbable site for the remote control station. Others help maintain records, raise funds, handle technical operations or announce.

For Gantt and Sachs, the short trips from the world of commerce through the Jazz District to the unmarked door go a long way toward providing relaxation and pleasant listening for thousands.

Gantt received a B.S. degree in geology from the University of Nebraska in 1941. After joining Gulf in 1946, he instructed geology in the University of Houston evening school for three years.

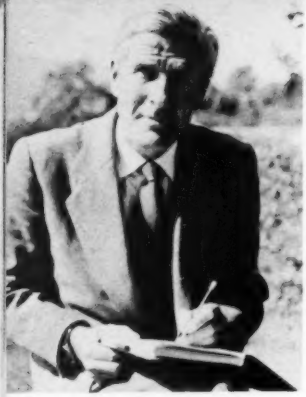
Geologist Sachs joined Gulf in 1955 at Houston after receiving a B.S. degree in geology from Columbia University, and an M.S. degree in geology from New York University.

Sinister Setting. Hidden here in the New Orleans French Quarter, the center of the homeland of Jazz, is an FM classical music broadcasting site.

Disk Jockey-Geologists Gantt at the control panel and Sachs at the turntable devote long hours of their own time to promote serious music over FM radio.

New Scholarships at Syracuse

Dr. William B. Heroy, Sr., alumnus, has recently established the Thomas Craemer Hopkins Scholarships in Geology at Syracuse University, in honor of an outstanding geologist, teacher, and former chairman of the Department. Scholarships in the amount of approximately two hundred dollars ($200.00) each will be awarded yearly to the outstanding junior and outstanding senior geology majors.



AGI VISITING INTERNATIONAL SCIENTISTS 1961

Six prominent internationally known geological scientists to participate in college lecture tours

Above
Augusto Gansser

Below
Hisashi Kuno

Under auspices of the Visiting International Scientist Program of the American Geological Institute a group of outstanding foreign scientists will be visiting graduate departments of geological science during the current academic year. This program was first conducted by AGI in 1960 and has been made possible through financial assistance of the National Science Foundation.

The visiting geologists who will participate in the 1961 program are:

PROFESSOR R. W. VAN BEMMELEN
University of Utrecht
Utrecht, Netherlands

PROFESSOR ROLAND BRINKMANN
Department of Geology
University of Bonn
Bonn, Germany

PROFESSOR AUGUSTO GANSSER
Department of Geology
Federal Institute of Technology and
University of Zurich
Zurich, Switzerland

PROFESSOR JEAN GOGUEL
Sorbonne, and Director
du Service de la Carte Geologique
Paris, France

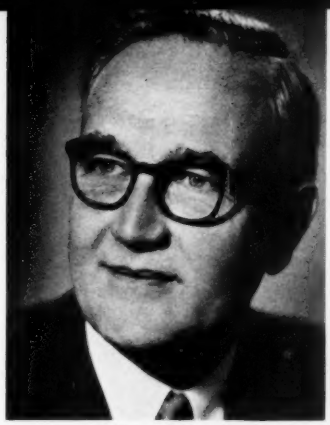
PROFESSOR HISASHI KUNO
Geological Institute
University of Tokyo
Tokyo, Japan

HENDRIK SCHUILING
Consulting Geologist
Union Miniere du Haut Katanga
Bruxelles, Belgium

Each of the participating geologists will be in the United States for a period of three months. Each will visit eight or nine graduate departments for one-week periods to lecture and to participate in seminar discussions with both students and staff. Each visitor will have a certain amount of free time during his tour to further his own research interests through contacts with fellow scientists in this country, for visits to private and public research facilities and for field trips in areas of particular geologic interest.

Professor van Bemmelen, a specialist on tectonics and volcanism is prepared to lecture on the following:

- *The Geology of Indonesia*
- *Volcano-tectonic Collapse Structures in Java and Sumatra*



R. W. van Bemmelen

Jean Goguel

Roland Brinkmann

- *Relations between Human History and Volcanism in Central Java*
- *The Theory of Gravity-Tectonics*
- *New Views on East-Alpine Orogenesis*
- *The Alpine-Dinaric Suture*
- *The Method of Geology.*

Professor Brinkmann's scientific specialties are physical geology and paleogeography. His lecture topics include:

- *Tectonic Evolution of Europe*
- *Goethe and Geology*
- *Diapirs in Northwestern Germany and Northern Spain*
- *Varisican Mountain Building in Central Europe*
- *Application of the C^{14} Method to Geohydrology and Pedology*
- *Cross-bedding in Clastic Sediments*
- *The Deformation of Fossils & Rocks*

Professor Gansser is known for his scientific research on regional geology, structural geology, petrology and petroleum geology. He will lecture on the following subjects:

- *Problems of Alpine Geology*
- *Orogenic Belts and Ophiolites*
- *Tectonics of Mountain Chains*
- *On Salt-domes and Mud-volcanoes*
- *Oil Search in Central Iran*

Professor Goguel is a specialist on tectonics, alpine geology, engineering geology and geophysics and has served the French Government in various capacities in the areas of geology and geophysics. He is prepared to lecture on:

- *Some Recent Results on Geology of the French Alps*
- *Mechanical Study of Folding*
- *Tectonic Deformation in Relation with Geophysics*
- *Thermodynamic Behavior of Water in Hot Areas*

Professor Hisashi Kuno is a specialist in igneous petrology and volcanism. His lecture topics include:

- *Origin of Primary Basalt Magmas*
- *Mohorovicic Discontinuity*
- *Crystallization of Pyroxenes from Rock-magmas*
- *Igneous Rock Series*
- *Pyroclastic Rocks*
- *Outline of the Geology of the Japanese Islands*
- *Volcanoes of Japan*
- *Volcanoes*

Hendrik Schuiling served as chief geologist for Union Miniere du Haut Katanga for many years and has been responsible for the geologic mapping and exploration program of that company in the Congo. He headed the geological field work which resulted in the geologic mapping of much of southern Katanga and in the recognition of the tremendous thrust sheet, remnants of which contain the important bedded ore deposits of Kakontwe, Musonoi Ruwe, Kolwezi. Information on Mr. Schuiling's lecture topics were not available when GeoTimes went to press.

The itinerary of each of the visiting scientists is built around the eight to nine scheduled visits to the graduate departments and the particular wishes expressed by the scientist as to the use of his free time. Local organizations and individuals wishing to learn details of the itinerary of any of the visiting scientists may request this information from AGI. Scheduling details are being handled by AGI in an effort to avoid overburdening the individual visitors.

Michel T. Halbouty, Houston petroleum geologist, engineer and independent producer, has been named Chairman of the AGI Finance Committee by President Ian Campbell. In this capacity Mr. Halbouty becomes a member of the AGI Executive Committee. He holds membership in six AGI Member Societies: AAPG, GSA (fellow), AIME, MSA, SEcG, and SEPM. He is also a member of the AAAS, API, IPAA as well as other national and local scientific and technical organizations. He is an authority on the petroleum geology and engineering of the Gulf Coast of Texas and Louisiana, and his company is active in Alaskan petroleum exploration. In addition to his scientific papers he is co-author of a popular book on Spindletop (Random House) and has several other books in preparation. Mr. Halbouty has taken an active interest in the affairs of the numerous scientific and technical societies to which he belongs and is active in many Houston civic affairs.

Chulalongkorn University Needs Geologic Literature

Professor Theo. H. F. Klompe of the newly-formed Department of Geology at Chulalongkorn University in Bankok has written colleagues in the U. S. concerning problems of equipping a new department. The needs of his department are many, but most pressing is the need for journals, geologic maps, reference books and other library materials. Journals of the GSA and AAPG are desired in particular. Fossil, rock and mineral collections are also needed.

Institutions, organizations or individuals desiring to aid this new department are urged to write *Prof. Theo. H. F. Klompe, Department of Geology, Chulalongkorn University, Phya Thai Road, Bangkok, Thailand.*

GEOLOGIC DIVISION OF THE USGS REORGANIZES

The Geologic Division of the U. S. Geological Survey has recently effected an extensive reorganization of its operational structure. The need for change has been brought about by the growth of the Division during the past decade and by the increasing facets of geologic research with which it must keep abreast.

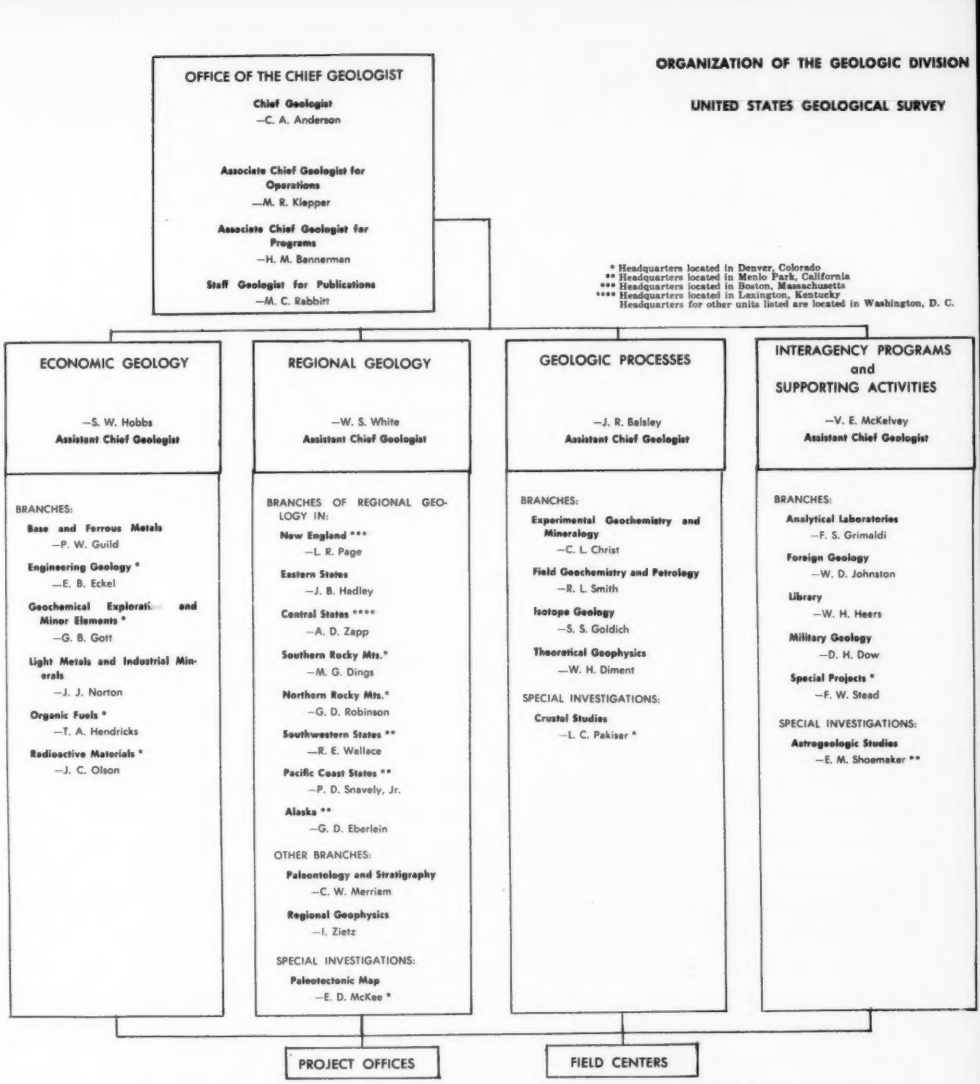
For the past several years, the Geologic Division consisted of eight operating branches that were concerned with activities largely funded by direct appropriations: Alaska, Engineering, Fuels, General, Geochemistry and Petrology, Geophysics, Mineral Deposits, and Paleontology and Stratigraphy. Two other branches were funded by transfers from other governmental agencies: Foreign Geology was funded by the International Cooperation Administration, and Military Geology was funded principally by the Corps of Engineers.

The new organization is based on 25 branches, grouped into four broad fields that span the functional activities of the Division: (1) economic geology; (2) regional geology; (3) geologic processes, and (4) interagency programs and supporting activities. The organization chart (figure 1) shows the realignment of the Division, identifies the Chief Geologist and principal staff officers (all located in Washtion, D. C.) and lists the names and headquarters of the new branch chiefs.

The principal functions and responsibilities of the four major operating units as now defined are summarized briefly below:

A. *The Branches concerned with Economic Geology* are responsible for studying and evaluating the mineral and mineral fuel resources of the nation, for research aimed to classify mode of occurrence and origin and for development of concepts to aid in the search for new deposits, and for research aimed at the practical application of geology to civilian engineering and land use problems.

B. *The Branches concerned with Regional Geology* are responsible for the preparation of a geologic map of the nation and the development of geologic prin-



ciples. This is achieved by systematic geologic mapping, generally on a quadrangle basis, supplemented by regional stratigraphic, paleontologic, and geophysical studies. Although the objectives of these surveys are not defined in terms of a specific economic justification, the investigations include the presentation and analysis of data on all potentially economic materials within mapped areas and provide the background of regional geologic data that is necessary for the economic geology program.

C. *The Branches concerned with Geologic Processes* are responsible for the conduct of fundamental field and laboratory research, applying the principles of physics, chemistry, mathematics, and other scientific disciplines to the solution of geologic problems and the extension of geologic concepts.

D. *The Branches concerned with Interagency Programs and Supporting Activities* are responsible for large, diverse programs conducted on behalf of and funded by other federal agencies, and for the operation of the analytical laboratories and library, which support all phases of the program.

YOU hold the to AGI

Through your understanding

Through your efforts

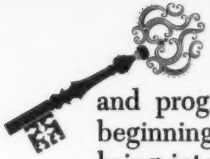
Through your financial support

The American Geological Institute works for the advancement of geology and the welfare of geologists in the areas of public education, public relations, government relations and professional relations. The Institute is a federation of scientific societies which are in turn composed of individuals interested in the various facets of the geological sciences. AGI *thus* is the instrument of the individual members of the AGI Member Societies.

You—*as a member of an AGI Member Society*—are a part of AGI. You constitute approximately 1/25,000th of the total body of geological scientists who comprise the AGI.

The effectiveness of AGI working on behalf of the advancement of geology and in the interests of geological scientists is directly related to the collective and positive efforts of you and other geologists who are the AGI.

Your interest in AGI may be motivated by personal pride in geology as your chosen professional pursuit and by your dedication to the science of geology. Conversely, if you lack interest in AGI it may be the result of the general lack of tangible benefits currently accruing to the benefit of the individual. AGI is oriented to benefit geological scientists collectively rather than individually. Furthermore it is oriented toward the future and its effectiveness can be expected to grow with the passing of time. Essential to that growth is continuing understanding, energy and support of geological scientists individually and collectively.



UNDERSTANDING There is need for geological scientists to understand the organization, operations and programs of AGI. A review of back issues of GeoTimes, beginning with the October 1958 Tenth Anniversary Issue, will bring into focus the broad spectrum of AGI's services to the profession. Particularly it must be understood that AGI exists primarily for the benefit of geological scientists collectively, not individually.

EFFORTS The Institute can be only as effective as the energies put into making it effective. If individuals and groups within the framework of AGI find the Institute lacking in specific regards, then it should be the energies of these individuals and groups which are marshalled to meet these deficiencies. These efforts, of course, must be in the best interests of geology and geologists.

FINANCES Member Societies collectively are pledged to support of AGI in 1961 only at the level of about a dollar ($1) per head ($22,000). This provides only for the most basic expenses of an AGI—for a name on a door, for a salaried representative and secretary and for minimum operating expenses. Additional operating funds through contributions from the profession have been and are now necessary to maintain AGI, its publication of GeoTimes and its maintenance of many existing services and programs for the benefit of geology and geologists. *There is a level of support of AGI to match your means.*

AID

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THROUGH

YOUR

CONTRIBUTION

The Committee of One Hundred

Pledge a contribution of $100 per year for 5 years. Alternatively give the equivalent in stock. There are about 70 members of the Committee of One Hundred

The Committee of 1000 for 1961

Contribute $10 or more and be enrolled as a member of the Committee of 1000 for AGI. In 1960, over 600 names of the Committee of 1000 for 1960 were published in GeoTimes

Contributors of $2 or more for GeoTimes

A contribution of $2 or more will provide for your share of GeoTimes and AGI activities. In 1960, 925 individuals contributed $2,864.39 to this fund.

Your contribution to the American Geological Institute is tax-deductible

Modern Learning Aids . . .

FILMS

by

CHALMER J. ROY,
Chairman, AGI Education Committee

A lot of time, money, and top-notch scientific talent has recently been devoted to the problem of producing educational materials. Several well organized operational groups, notably those in physics, chemistry, biology, and mathematics, are producing an enviable variety of materials. Of interest here are the films they have produced.

These groups have found it necessary to develop principles and standards for the purposes and functions of classroom films. These principles and standards, in summary, are three-fold.

1. Learning aids: The primary purpose of a classroom film is to serve the learner. The design and production of the film must be predicated on the principle that it is to be a learning aid rather than a teaching aid. Anyone who has viewed very many classroom films will readily appreciate the difference.

2. Films must set the tone of the course: Although this is also the truest function of the text book, it applies especially to the film. The value of a film as a learning aid is destroyed by oversimplification of subject matter, superficiality in treatment, attempts to cover too much subject matter, and advertising. Last, but not least—the film must be short.

3. Films must ask questions: When the lights come on after showing a film, there should be a rush of questions seeking explanations of things just seen. This affords a real opportunity for effective teaching and learning. The usual "teaching aid" film is inclined to answer a lot of questions no one is asking, or leave the students with the impression that they have just been visited by a special consultant. Few, if any, will dare question the pontifications of the visiting lecturer.

Making an effective classroom film requires three things:

1. *An author to develop a script*—or at least an outline—of what is to be done. The idea must concern something which should be learned and which can be effectively presented only on film. The author must be convinced that the film is really necessary, and that if it is to be done effectively, he must be the one to do it. This will require work as well as inspiration.

2. *Producing equipment:* Making modern classroom films in science requires a considerable assortment of specialized gimmicks and gadgets in addition to lights, cameras, film processing and editing equipment, and projectors.

3. *Producing personnel:* A considerable variety of technically competent people with interest and experience in making science films.

4. *Sponsorship:* There are two kinds of sponsorship which are essential; on the one hand financial and on the other an organization to control over-all planning and scientific consistency of such films.

Producing equipment and personnel are available in several commercial studios and in studios developed by other scientific groups but a program of film making in geology will require authors and sponsorship. The AGI Visual Education Committee and the AGI Education Committee have had film-making under study for several years but the Institute has not yet decided to take the plunge. It is evident that some foundation support could be expected to get a film program underway. Needed are potential geologist authors, ideas, enthusiasm and hard work.

William R. Meuhlberger has recently been named chairman of the Visual Education Committeee of the American Geological Institute. Dr. Muehlberger is a member of the faculty of the Department of Geology, University of Texas.

Other scientific disciplines are far beyond the toe-testing stage in the film-making pool—they jumped in some time ago and are swimming along. Those interested in film programs of other scientific groups should write

for physics: Modern Learning Aids, 3 East 45th St., N.Y., N.Y.

for chemistry: Mr. Robert Silber, American Chemistry Society, 1155-16th St., Washington 6, D. C.

for biology: Dr. Arnold B. Grobman, U. of Colorado, Boulder

for mathematics: Dr. Robert Wisner, Dept. of Mathematics, Michigan State U.-Oakland, Rochester.

for meteorology: Mr. Kenneth C. Spengler, American Meteorological Society, 45 Beacon St., Boston.

Geologists will be particularly interested in the following physics films available from Modern Learning Aids: Crystals, Forces, Universal Gravitation, Frames of Reference, and Long Time Intervals.

Dr. Georg Wust, professor emeritus of geology and past director of the Institution fur Meereskunde (for marine research) of Kiel University, Germany, is currently conducting a course in oceanography and research at the Lamont Geological Observatory of Columbia University.

Planet Earth Films Released

The Planet Earth film series produced under the auspices of the U. S. National Committee for the International Geophysical Year, National Academy of Sciences–National Research Council, consisting of thirteen 16 mm 27-minute educational films, is now available through the distribution facilities of the McGraw-Hill Book Company.

The films, produced under a grant from the Ford Foundation, are available in both black & white and color. The thirteen films are listed by title as follows:

- *The Hidden Earth*
- *The Shape of the Earth*
- *The Force of Gravity*
- *The Inconstant Air*
- *Secrets of the Ice*
- *Challenge of the Oceans*
- *Our Nearest Star*
- *The Flaming Sky*
- *Magnetic Force*
- *Radio Waves*
- *Cosmic Rays*
- *Research by Rockets*
- *Science in Space.*

Geologists Carey Croneis and Laurence M. Gould served on the advisory committee for the film series.

McGraw-Hill will distribute the films, either severally or in sets, both in the United States and abroad, to educational and research institutions at a price of $80.00 for the black-and-white prints, and $150.00 for the color prints. The entire series is now available for preview at the *McGraw-Hill Text-Films, 330 West 42nd Street, New York, N. Y.*

FORDHAM SEISMIC OBSERVANCE—At the recent symposium (Saturday, Dec. 10) held in observance of the 50th anniversary of the Seismic Observatory founding at Fordham University, the above-pictured scientists (shown with the Very Reverend Laurence J. McGinley, S.J., center, President of Fordham) presented papers before an audience of 100 invited guests in the one-day meeting. Pictured (left to right) in the Campus Center of the University are: Reverend J. Joseph Lynch, S.J., Fordham Observatory director for 35 years; Reverend William Stauder, S.J., director of the Seismological Observatory, St. Louis University; Dr. Bartholomew Nagy, director of the Organic Geochemical Laboratory of Fordham; Father McGinley; Leonard M. Murphy of the Division of Seismology, U.S. Coast and Geodetic Survey; Dr. Frank Press, director, Seismological Laboratory, California Institute of Technology and U.S. delegate to the Geneva Disarmament Conference; Dr. Maurice Ewing, director, Lamont Observatory, Columbia University, and past president of the Seismological Society of America; Reverend Henry Birkenhauer, S.J., director, Seismic Observatory, John Carroll University.

Field Institute for Geology Teachers

The Department of Geology, Indiana University is conducting a Summer Institute in Field Geology for College Teachers of Geology at its Geologic Field Station in the Tobacco Root Mountains south of Cardwell, Montana during the summer of 1961. A grant from the National Science Foundation has been made in support of the Institute. A similar Institute conducted in the summer of 1960 was reported in *GeoTimes*, Nov.-Dec. 1960, p. 20-22.

In addition to the regular teaching staff of the field institute a group of twelve visiting specialists will participate for periods of one to three days. Thirty-six participants will be selected for the institute and will receive stipends, allowance for travel and allowance for dependents.

Closing date for applications is February 15. Additional information may be obtained from the *Department of Geology, Indiana University, Bloomington, Indiana.*

Leo J. Peters has recently been appointed Vice President and General Administrator of the Gulf Research and Development Company.

As a member of the staff of Gulf Research and Development Company, with which he has been associated since 1929, Dr. Peters has devoted his time to many phases of the fundamental theory of geophysical methods, the interpretation of geophysical data, and the design of equipment.

Mineralogical Association of Canada

The Mineralological Association of Canada was incorporated in 1955 for the purpose of advancing knowledge in the mineral sciences, and now has a membership of about 600, drawn from more than 20 countries. It sponsors the publication of The Canadian Mineralogist, a journal similar in subject matter and format to the American Mineralogist. Prior to 1956 the predecessor of The Canadian Mineralogist appeared as "Contributions to Canadian Mineralogy," published as separate issues of the American Mineralogist. At the present time the Canadian Mineralogist is published once a year, but it is hoped to increase the frequency of publication in the future. Back numbers are still available.

Membership in the Association is open to anyone interested in mineralogy or related fields. An application form for membership may be obtained by writing *E. H. Nickel, Chairman, Membership Committee, Mineralogical Assoc. of Canada, 300 Lebreton Street, Ottawa, Ontario.*

GEOLOGY in the Public Eye

by **Robert L. Bates**

Department of Geology, Ohio State University

G. P. Woollard had an illustrated article on "The Crust of the Earth" in *The Science Teacher* for last September. (*The Science Teacher* is a magazine for science teachers, published by the National Science Teachers Assoc.) Seismic measurements, gravity anomalies, isostatic equilibrium—it's all there. If this is the sort of diet that high-school teachers feed on, we need not fear that they are ill-informed or unable to handle complex subjects. . . . Eleven columns of space in *Sports Illustrated* last October 10 were occupied by a story on rock collecting. "Roll Out the Rocks," by Cynthia Lindsay, is a nice discussion of the species rockhound, what he is after, and the strange compulsions that drive him. It introduces the reader to terms like geode, gastrolith, and fulgurite, and to eminent persons like Dick Jahns and Frederick Pough. The article should stimulate the sale of hammers, knapsacks, and state survey booklets on rocks and minerals. . . . American Education Publications is a concern that puts out a variety of printed materials for grade-school youngsters (including, so help us, something for third-graders described as "Creative Seatwork"). It has just published a 32-page leaflet by H. J. Pincus, entitled *"Secrets of the Sea—Oceanography for Young Scientists."* Practically all phases of the subject are described in text, photo, and diagram. At the back are 2 pages of up-to-date bathymetric charts on which oceanic currents are shown. The whole thing gives the impression of a field of science full of challenging problems and being vigorously studied. . . . Now appearing daily in a lot of newspapers is an illustrated panel called "Earth, Stars and Man" by Don Oakley and John Lane. These gentlemen successfully combine simple treatment and scientific accuracy. Who would have thought, a few years ago, that we would find in our morning paper a discussion of Neptunism vs. Vulcanism, complete with pictures of Werner and Hutton? . . . Latest addition to the West Virginia Survey's educational series is *"A Guide to the Common Fossil Plants"* of the state, by W. H. Gillespie and I. S. Latimer, Jr., Slick paper, 60 pages, many half-tone photos and drawings. A good job.

GEOTIMES

INDEX

July 1956 to May-June 1960

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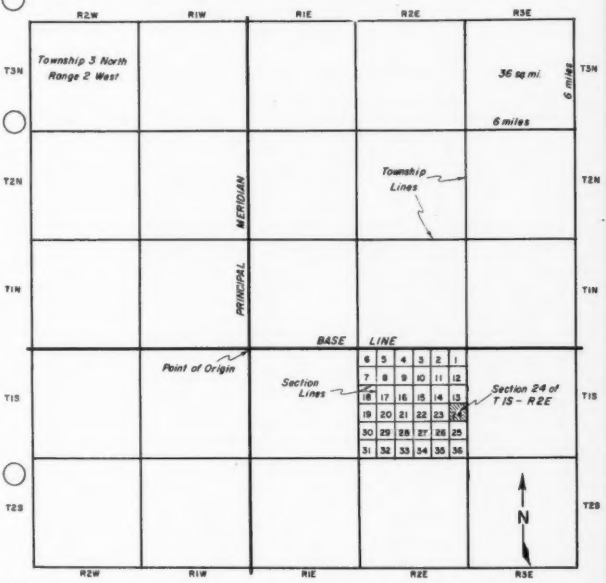
U.S. PUBLIC LAND SURVEY GRID

compiled by
ANDREW J. MOZOLA

TOWNSHIPS ARE NUMBERED NORTH AND SOUTH OF THE BASE LINE, AND EAST AND WEST OF THE PRINCIPAL MERIDIAN. EACH TOWNSHIP IS A SIX MILE SQUARE THAT IS FURTHER SUBDIVIDED INTO THIRTY-SIX ONE MILE SQUARES CALLED SECTIONS. THE SECTIONS ARE NUMBERED CONSECUTIVELY FROM RIGHT TO LEFT AND LEFT TO RIGHT.



Additional copies of this data sheet may be obtained from the AMERICAN GEOLOGICAL INSTITUTE, Cost $0.10.

Data Sheet 22

This data sheet is number 22 in the AGI series of helpful information which have been prepared under the guidance of the Data Sheet Committee which consists of the following members:

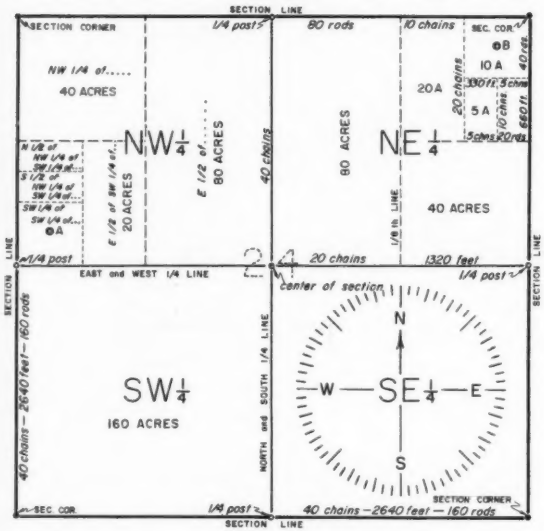
JOHN E. ALLEN, WILLIAM BEATTY, CHESTER LONGWELL, GEORGE THOMPSON, IAN CAMPBELL, BOB WALLACE, and RICHARD M. FOOSE, *Chairman.*

Bob Wallace of the U. S. G. S., Menlo Park replaced Vincent McKelvey who recently resigned from the committee.

Suggestions for additional data sheets are welcomed and should be forwarded to *Dr. Richard M. Foose, Earth Science Division, Stanford Research Institute, Menlo Park, California.*

SECTION 24

A SECTION OF LAND IS ONE MILE SQUARE CONTAINING 640 ACRES



MEASUREMENTS

ONE LINK= 7.92 inches; 100 LINKS=ONE CHAIN
ONE ROD= 16.5 feet; 25 LINKS
ONE CHAIN= 66 feet; 100 LINKS; 4 RODS
80 CHAINS= 5280 FT; ONE MILE; 320 RODS

ONE ACRE=43560 square feet; 160 square rods.
A SIDE OF A SQUARE ACRE= 208.71 feet.
ONE ARPENT= 2.9127 chains; 192.24 feet, or 0.848398 of an acre.

PT. A = CTR., SW 1/4, SW 1/4, NW 1/4, of SEC. 24, T 1S, R 2E
PT. B CTR., NE 1/4, NE 1/4, NE 1/4, of SEC. 24, T 1S, R 2E

MEMBER SOCIETIES
of the
AMERICAN GEOLOGICAL INSTITUTE
June 1960 Edition

A 16 page booklet which gives data on the organizations, history, purpose, membership requirements, publications, and other pertinent information on the fourteen Member Societies of the American Geological Institute.

Lists present officers of all Societies.

Free on request from

AMERICAN GEOLOGICAL INSTITUTE
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AGI LIST OF PUBLICATIONS

AGI has recently published a new list of publications, listing the various journals and other publications published by AGI.

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AAPG Field Trips

Persons desiring information on the five field trips planned in connection with the Denver AAPG-SEPM meeting, April 24-27, 1961, may obtain a descriptive brochure and registration forms by writing *John R. Hayes, Geology Department, Colorado School of Mines, Golden, Colorado.*

Popular Geology in print

by Mark W. Pangborn, Jr.

The apparently limitless color-printing resources of the Golden Press have been brought to bear upon the subject of physical geology, and the singularly handsome result in THE STORY OF GEOLOGY, by *Jerome Wycoff* (Golden Press, 1960, $4.95). Aimed at both older children and uninitiated adults, this gorgeously illustrated introduction, with its hundreds of beautiful color pictures, touches on a rather wide range of subjects—mountain making, erosion, volcanoes and earthquakes, rocks and minerals, relict magnetism and continental origins, sea bottom geology and radiocarbon dating. The text is generally accurate, although it contains enough oversimplifications to give a finicky geologist ulcers. Quite a few of the block diagrams are faultily conceived or mislabeled; where were the editors? THE STORY OF GEOLOGY seems destined to sell well, so it is most unfortunate that there is no annotated bibliography to lead the interested reader to the more specialized non-technical literature.

Aimed at the same audience is THE EARTH: ROCKS, MINERALS, AND FOSSILS (Watts, 1960, $4.95), in which British geologist *Walter B. Harland* attempts to summarize the principles of general geology. First, Harland surveys the contributions of the great geologists, then pictures the physical constitution of the earth and describes the various processes at work today; historical geology and evolution are briefly touched upon, and the book concludes with sections on mineral resources and on collecting as a hobby; the index is interestingly combined with the glossary. The illustrations vary greatly as to quality and relevance, and the text has its share of errors; as in *The Story of Geology*, this book needs a bibliography.

Anthropologist *Frank C. Hibben* hits the high spots of North American prehistory in DIGGING UP AMERICA (Hill and Wang, 1960, $5), a revision of his "Treasure in the dust," 1951. Hibben sketches some major finds, describes how artifacts are dated, speculates on how man reached North America, what he ate, and how he lived, and looks at the Mound Builders, the Mayas, and the Incas. The author wears his learning lightly—in fact, almost too much so!—and we hope that the next edition of this book, suitable for both layman and teen ager, will include maps and chronological tables, and is beefed up in the picture department; a good short bibliography is furnished.

Arthur S. Dickinson, Houston district geologist for the Lion Oil Company, a Division of Monsanto Chemical Company, has been named an **exploration geologist** under Lion's new advancement plan for rewarding and making effective use of geologists and geophysicists who find oil for the company. Dickinson is the first appointee under the company's scientific advancement plan that permits a path of progression through performance in geologic investigations parallel to the traditional advancement through administration and management. The new program is aimed at relieving of administrative responsibilities key geologists and geophysicists with proven exploration abilities in order that they may apply their efforts to the scientific problems in exploration facing the company and at the same time be recognized through increased stature and rewards for their scientific contributions.

NSF Supports Adirondack Research

Dr. Dirk de Waard, Associate Professor of Geology, Syracuse University, has recently been awarded a National Science Foundation grant to support a three-year study of "Metamorphic-Tectonic Analysis of Precambrian Structures in the Southwestern Adirondack Mountains."

HIDDEN EARTH. 16 mm. Sound. Color, and B. and W. 28 minutes. 1960. A geologically oriented film in the "Planet Earth" series prepared under the aegis of the NAS-NRC, as part of its IGY activities. It begins by posing some questions about the nature of the earth's interior, thus calling attention to research frontiers now puzzling earth scientists. Then it considers some of the tools and techniques used to probe the "hidden earth," tools such as the seismograph, and techniques such as the creation of artificial tremors to measure the nature and thickness of Antarctic ice. Earthquake waves, including microseisms, are discussed, together with their roles in delineating the nature of the crust, mantle and core, and the Mohorovicic and other discontinuities. Volcanism is examined in the light of present knowledge, and several related intriguing theories outlined—the condensation of our earth and other planets from a gaseous cloud, and the possible present expansion of our earth as evidenced by the supposed rift-like structures encircling our globe beneath the oceans. At the end the film even briefly mentions man's present plans to put a seismograph on the moon. For all who are interested in the earth and its mysteries. DISTRIBUTOR: *Text-Film Dep't., McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. (for purchase), or many film libraries (for loan). In Canada write McGraw-Hill, 253 Spadina Road, Toronto 4, Canada.*

MAGNETIC FORCE. 16 mm. Sound. Color, and B. and W. 28 minutes. 1960. Although known for more than 2,000 years, magnetism is almost as much a mystery now as it was to the ancient Greeks. This film, one of the "Planet Earth" series assembled by the NAS-NRC as part of its IGY activities, focusses on this strange force, from ancient times to modern, telling of its measurement and its effects upon the earth. Problems associated with our planet's magnetic field, such as the shift of the field with time, and its decrease in intensity over the last 100 years, illustrate how much remains to be learned about our earth. The aurora, the Van Allen belt, and other evidences of magnetic fields in space also receive attention. For elementary students in field and general geology, and for the scientifically curious and informed public.

Rock Mechanics Symposium

Penn State
Mar. 30 to
April 1

Both theory and practice will be covered by papers to be presented at the Fourth Symposium on Rock Mechanics, being held at Penn State on March 30 to April 1, 1961. While the emphasis will be on application to problems of mining technology and science, petroleum engineers, geologists, geophysicists, civil engineers, and military engineers as well as mining engineers will find much of value being presented.

The program consists of four technical sessions on these subjects: (1) behavior of rock under static loading, (2) behavior of rock under dynamic loading, (3) measurement of rock properties and stress instrumentation, and (4) ground control and subsidence. Papers to be presented include stress adjustment by roof control, behavior of rock beams under impact, new developments in physical properties measurement, photoelastic determination of stress adjacent to a cratered surface, stress waves from rock bursts, fracture patterns around underground openings, pre-stressed concrete pillars, stress distribution in rock beneath a drill bit, brittle fracture phenomena in rock, and anchorage slippage in roof bolting.

The symposium is under the joint sponsorship of the departments of mining at Colorado School of Mines, University of Minnesota, Missouri School of Mines and Metallurgy, and The Pennsylvania State University. Missouri joins the other institutions for the first time this year in sponsoring the symposia which rotate among the schools on an annual basis. For information write *Department of Mining, The Pennsylvania State University.*

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Canadian Meeting Theme

Exploration Geophysics

Today and Tomorrow

The Canadian Society of Exploration Geophysicists, concurrent with its annual meeting, will sponsor a Conference to be held in the PALLISER ROOM, PALLISER HOTEL, CALGARY, ALBERTA on *February 27, 1961*. The program, with the speakers confirmed to date, is as follows:

ECONOMIC ASPECTS

Influence of World Oil Reserves on Exploration Economics

Invitation pending

Economics of Geophysics in Oil Exploration

Paul L. Lyons, Chief Geophysicist, Sinclair Oil and Gas Co., Tulsa, Okla.

Trends and Prospects in Mining and Engineering Geophysics

Norman R. Paterson, Chief Geophysicist, Hunting Survey Corp., Ltd., Toronto, Ont.

Problems of the Geophysical Contractor

Charles M. Moore, Vice President, Geophysical Services, Inc., Dallas, Texas.

Geophysics' Share of Todays Exploration Dollar

Leo R. Newfarmer, Exploration Manager, Shell Oil Company, Houston, Texas.

TECHNICAL ASPECTS

Technical Limitations of Present Geophysical Tools

W. T. Born, Director of Laboratories, Geophysical Research Corp., Amerada Petroleum Corp., Tulsa, Okla.

Current Research to Improve Effectiveness of Standard Geophysical Methods

F. A. Van Melle, Research Seismologist, Shell Development Co., Houston, Texas.

Status of Direct Oil Finding Methods (Geochemical, Electrical, etc.)

Invitation pending

John K. Gustafson was recently named President of the Homestake Mining Company with head offices in San Francisco. Dr. Gustafson, an economic geologist, was formerly Vice President of the M. A. Hanna Company. He succeeds geologist Donald H. McLaughlin as President of Homestake. Dr. McLaughlin has become Chairman of the Board.

PERSONNEL PROBLEMS

Statistics on Employment of Exploration Geophysicists

Colin C. Campbell, Business Manager, Society of Exploration Geophysicists, Tulsa, Okla.

Alternative Employment for Geophysicists in the Oil Industry

D. C. Jones, Vice President for Production, Hudson's Bay Oil and Gas Co., Calgary, Alta.

Impact of the Present Slump on Geophysical Education

John C. Hollister, Head of the Dept. of Geophysics, Colorado School of Mines, Golden, Colo.

The meeting will be addressed by Dr. J. P. Woods, President of the Society of Exploration Geophysicists. The title of his talk will be *How Geophysicists Can Meet the Present Situation.* Additional information on the meeting may be obtained by writing *James B. Murphy, Publicity Chairman, P.O. Box 117, Calgary, Alberta, Canada.*

MANPOWER *in a column —*

By HOWARD A. MEYERHOFF
Scientific Manpower Commission
1507 M Street, N.W., Washington 5, D. C.

The Department of Labor is revising the Occupational Outlook Handbook. Its authors are most anxious to avoid false alarms, and this year they are looking extra hard at geology and geophysics. They have made those of us in their path here in Washington look hard, too. As significant as the current situation is, to them the five-year outlook is no less important. After all, it takes several years to make a good scientist in any field.

On close scrutiny the future looks different, but not too bad.

Water supply problems increase apace. It is a field of growing importance. Allied with ground water problems is a specialty of mushrooming significance—namely, secondary oil recovery. In 1959, according to *Petroleum Week,* secondary recovery accounted for only 189 million barrels of Texas' oil production. In 1960 the estimate is 550 million barrels.

This is oil that would otherwise be lost. Its recovery means less drilling, less exploration, but sound conservation. Secondary recovery may be a phase of oil field engineering, but it has its roots in the physical and chemical characteristics of reservoir rocks. Every producer may profitably initiate—or intensify—studies of all his leaseholds to weigh the economics of secondary recovery. And the studies are essentially in sedimentary petrology and hydrology or—if we may coin the words—carbohydrology and electrogeophysics.

Technology has cut back exploration in the metals, too. Commercialization of taconite is one example. Synthesis provides others that promise to change raw materials requirements. Here, too, petrology, coupled with chemistry, bids fair to become a basic background subject to identify ore deposits that will meet the growing demands of industry.

Somewhat slower, but more dependable in its evolution, is engineering geology in an age of construction, in which bigger bridges, taller skyscrapers, wider roads, and higher dams call for precise data on foundation and strength of materials.

More remote, perhaps, but no less certain, is a day of new domestic exploration—by geophysics, geochemistry, and more precise geology—not merely to replace depleted ore deposits known today, but to protect the nation against the nationalism that cut off 18 percent of the world's nickel supply in Cuba, 60 percent in the industrial diamond supply in the Congo.

We may have to change the curricula in our colleges and graduate schools. And shouldn't we start now?

GSA Cordilleran Section Meets at San Diego

The Cordilleran Section of the Geological Society of America will hold its 57th annual meeting on the campus of San Diego State College, San Diego, California, March 27-29. Meeting with the Cordilleran Section will be the Seismological Society of America and the Pacific Coast Branch of the Paleontological Society.

Four field trips are planned as follows: Geology and Geomorphology of Eastern San Diego County; Geology and Geomorphology of Southwestern San Diego County; Scripps Institution of Oceanography Research Vessel "Horizon"; and Geology of Northwest Baja California, Mexico. It is possible that a field trip to pegmatite areas may also be conducted.

Hosts for the meeting are San Diego State College, its Department of Geology and the student honor society in geology, the "Tectons-Delvers."

Information on the meeting and housing may be obtained by writing the *Department of Geology, San Diego State College, San Diego, California.*

Tenth Pacific Science Congress

Honolulu, Hawaii
August 21 to
September 6, 1961

A comprehensive circular of information has been released concerning the Tenth Pacific Science Congress scheduled for Honolulu, Hawaii, August 21 to September 6, 1961. Hosts to the Congress are the National Academy of Sciences, the Bishop Museum, and the University of Hawaii. The announcement gives details on the scientific program, field trips, social functions, accommodations, etc. Wives of attending members must register as auditors.

Copies of the circular of information may be obtained by writing *Tenth Pacific Science Congress, Bishop Museum, Honolulu 17, Hawaii.*

The First Stebinger Memorial Symposium

This symposium was held at Northwestern University on December 3, 1960. The conference was attended by about seventy engineers and geologists from Canada, Mexico and the United States.

The program emphasized foundation problems in surficial materials and included such topics as the consolidation and waterproofing of granular material by chemical methods such as cementing and clay grouting.

Mr. Emile Huni, chief engineer of the Soletanche Company in Vancouver, discussed methods of waterproofing deep glacial alluvial fill in Southern France and in Northwestern Canada. Mr. Joseph Ramos of the Halliburton Company spoke on chemical grouting with numerous specific illustrations in dams and foundations. Mr. J. M. Edwards of the McCullough Tool Company discussed the gamma-gamma logging device as developed for oil exploration and considered its application to the determination of porosity and permeability in rocks or soils from their densities.

A lively discussion period including an exchange of experiences occupied the last part of the morning session. This discussion was moderated by Dr. Shailer S. Philbrick, senior geologist, Corps of Engineers, Pittsburgh. Dr. Parker D. Trask of the Engineering College of the University of California opened the discussion by bringing out recent developments in the study of water sediments. Dr. Arthur B. Cleaves of Washington University in St. Louis cited specific problems encountered in tunneling operations and pointed out some major problems in shutting off water.

The afternoon session was devoted to the legal aspects of engineering and geology as they affected decisions in landslide liability, water legislation, and the general problems of the responsibility of engineers. This part of the symposium was led by Professor George A. Kiersch of Cornell University.

Eugene Stebinger, in whose honor the symposium was held, was with the United States Geological Survey after attending the Universities of California and Chicago. Later he joined the Standard Oil Company (New Jersey) as chief geologist in Argentina and Bolivia, and subsequently became President of the Standard Oil Company of Bolivia. On his return from South America he became chief geologist of the Jersey Standard until his retirement in 1945. Mr. Stebinger passed away in 1951.

Mrs. Stebinger and her son Arnold, who is presently on the staff of Socony Mobiloil, donated Eugene Stebinger's library to the University of Illinois in Chicago and the Standard Oil Company (New Jersey) founded the Stebinger Memorial Fund by a substantial donation.

The Symposium was arranged by Dr. R. W. Karpinski of the University of Illinois in Chicago and Dr. J. Osterberg of the Civil Engineering Department at Northwestern University with the cooperation of Dr. A. L. Howland of the Geology Department. Deans H. B. Gotaas of Northwestern and F. Trezise of the University of Illinois attended the meetings.

It is anticipated that additional symposia will be held under the auspices of the Eugene Stebinger Memorial at biennial intervals with emphasis on problems in the borderland between engineering and geology.

Astrogeology Program Started by U. S. G. S.

A new program in Astrogeology is being undertaken by the U. S. Geological Survey in cooperation with and with financial support of the National Aeronautics and Space Administration (NASA).

The program includes geologic analysis of photographs of selected areas on the moon; terrestrial crater studies; investigations into the origins and composition of tektites, meteorites and related materials of possible impact origin; and experimental studies of the mechanics of impacting objects.

A reconnaissance terrain study consisting of three diagrams at a scale of 1:3,800,000 or 1 inch on the map equals approximately 60 miles on the moon, and an accompanying text of lunar data in tabular form has been recently completed by Geological Survey for the Corps of Engineers, U. S. Army *(GeoTimes, Oct. 1960, p. 27)*.

In the new studies to be undertaken for NASA certain geologic features of the moon will be examined more closely and larger scale diagrams will be prepared of specific areas in the vicinity of landing sites selected by NASA for instrument-loaded space vehicles. In order to gain all possible geologic information available in single as well as stereoscopic photographs, existing lunar photographic methods will be supplemented by several lines of investigation.

Ninth Lunar & Planetary Meeting Held

A report by
R. E. Eggleton and
C. H. Marshall
U. S. Geological Survey
Menlo Park, California

On November 2 and 3, 1960, the Ninth Lunar and Planetary Exploration Colloquium, with North American Aviation, Inc. at Downey, California, acting as host, brought together about 250 avidly interested people. Among them were a significant fraction of the Americans who are actively pursuing studies of the moon and planets. The program consisted of panel discussions on the topics of interpretation and mapping of the moon, physical and biological planetary studies, and lunar exploration. Panel chairmen included Harold C. Urey of the University of California at La Jolla, G. P. Kuiper of the University of Arizona, and Manfred Eimer and C. I. Cummings of the Caltech Jet Propulsion Laboratory.

Urey prefaced the first panel discussion by summarizing some theories concerning the moon, suggesting that capture of the moon by the earth seems more probable than accretion of the earth and moon as a binary system. He characterized the moon as chemically a more primitive object than the earth. The fact that the moon's center of gravity is north of its geometrical center was interpreted by him as evidence against the hypothesis that the bulk of the moon was molten at any one time. In the following panel discussion E. M. Shoemaker, U. S. Geological Survey, suggested that rates of meteorite infall for the earth and moon are consistent with the hypothesis that the "cryptovolcanic" structures in the central United States are of impact origin and that the lunar maria were formed about 4½ billion years ago. Dinsmore Alter, Aeronutronic Division, Ford Motor Co., presented further evidence that the moon has been captured by the earth. Jack Green, Aero-Space Laboratories, North American Aviation, Inc., compared certain chains of lunar craters with volcanic crater chains in Iceland.

G. P. Kuiper described the "Orthographic Atlas of the Moon" to be published soon by the University of Arizona. In this atlas an orthographic grid of selenographic coordinates is superimposed on lunar photographs. The grid provides the most precise system available for location of points on the lunar surface. R. W. Carder gave details on the series of lunar charts being produced by the Aeronautical Chart and Information Center. A series of shaded relief quadrangle maps on Mercator and polyconic projections at a scale of 1:1,000,000 are now in preparation.

A special feature of the colloquium, which served as the subject of the second panel, was a report by A. Dollfus, Paris Observatory, on results of observations of Mars during its 1954, 1956, and 1958 oppositions. Inferences on the chemical composition and particle size of Martian materials were drawn from studies of the polarization of the reflected light. Three types of surface areas undergo seasonal changes: light polar areas that are evidently covered with frost, yellowish areas which have polarization curves similar to those for powdered limonite, and dark markings that may be colored in part by organic material. The Martian atmosphere contains several varieties of clouds including blue morning and evening haze. Occasional diffuse yellowing that spreads over the planet, obscuring the markings and the polar areas, is apparently due to low level dust clouds. Very bright white stationary clouds are apparently localized by topographic prominences.

In the third panel, Carl Sagan, University of California at Berkeley, discussed the possibilities for existence of living matter and organic compounds on Venus, Mars, Jupiter, and the Moon. He suggested the possibility that a specific, anaerobic, blue-green alga from Earth, if added to the Venusian atmosphere, might thrive and add oxygen, remove carbon dioxide (thereby reducing the cloud blanket and temperature), and thus make the planet habitable by humans. K. M. Siegel, University of Michigan, described in the fourth panel the electrical properties and particle size of the material on the lunar surface as deduced from reflected light and radio waves. Terrestrial materials with similar properties were sought and tested for penetration characteristics, sonic velocities, and other physical properties.

Several descriptions of plans and equipment for unmanned and manned lunar exploration were given during the third and fourth panel discussions by Manfred Eimer and C. I. Cummings, and by Kraft Ehricke of Convair Astronautics. Three series of unmanned lunar probes are currently planned by NASA, the Ranger, Surveyor, and Prospector series. Probes in the Ranger series will make hard land-

HIGHWAY GEOLOGY SYMPOSIUM

Knoxville
Feb. 10-11

The 12th Annual Symposium on Geology as Applied to Highway Engineering will be held at the University of Tennessee on February 10-11, 1961, under the co-sponsorship of the Departments of Civil Engineering and Geology-Geography, University of Tennessee, the Tennessee Department of Highways and the Tennessee Division of Geology. The program for February 10 contains ten papers, selected to provide a wide range of geographical and topical interests:

N. C. Young and T. R. Pierce, Tennessee Department of Highways, *"Principal highway engineering characteristics of Tennessee formations"*

W. A. Goodwin, Tennessee Highway Research Program, *"Evaluation of pavement aggregates for non-skid qualities"*

D. R. Nichols and L. A. Yehle, U. S. Geological Survey, *"Highway construction and maintenance problems in permafrost regions"*

Kenneth A. Gutschick, National Lime Assoc., *"Altering physico-chemical characteristics of clay-bearing soil with lime"*

Charles McNutt, University of Tennessee, *"Highway salvage archeology"*

C. B. Officer, Marine Geophysical Services Corporation, *"Use of the continuous seismic profiler (sparker) in geologic investigations for vehicular tunnel and bridge crossings"*

R. W. Bailey, U. S. Forest Service, *"The Madison River, Montana, earthquake of 1959 and the highway problem"*

W. Harold Stuart, Corps of Engineers, *"Geological conditions complicating highway and railroad relocations in the Northwest"*

R. W. Moore, Bureau of Public Roads, *"Observations on subsurface explorations using direct procedures and geophysical techniques"*

C. W. Dorman, American Appraisal Co., *"The economics of mineral resource valuation"*

F. J. Cordova, Consultant, *"The application of engineering geology and soil mechanics in the design and construction of highways in the Great Lakes region"*

There will be an informal social hour at the Farragut Hotel on Thursday evening, and on Saturday, February 11 there will be demonstrations of current research by the Tennessee Highway Research Program, on the University campus.

Registration fee will be $1.00, and all registrants will receive a copy of the Proceedings. Inquiries may be directed to *R. A. Laurence, Room 11, Post Office Building, Knoxville 2, Tennessee.*

GSA Rocky Mtn. Section Meets in Laramie

The annual meeting of the Rocky Mountain Section, Geological Society of America will be held May 11-13 on the campus of the University of Wyoming, Laramie. Technical sessions and probably field trips will comprise the program. Members, nonmembers, and students are invited to submit papers. Abstract forms and further information may be obtained from: *John Montagne, Secretary, Rocky Mountain Section, GSA, Montana State College, Bozeman, Montana.*

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ings, taking photographs and relaying the information during approach. A rugged seismometer will listen for moonquakes after impact. Some Surveyor probes will enter lunar orbits and some will make soft landings with a variety of instruments on board for analyzing the lunar surface. The Prospector probes will carry devices capable of roving about the Moon's surface, and in the most advanced models will return samples to Earth. Target date for the first landings in the Ranger series is late 1961 or 1962.

At a dinner meeting, W. H. Pickering, Jet Propulsion Laboratory, expressed the feeling of many that we are still brought up short when we stop to realize that space is no longer in the realm of science fiction. He emphasized the need for the exploration program of NASA to produce tangible results if it is to have the continuing support of the public.

Inquiries as to availability of the proceedings should be directed to: *Lunar and Planetary Exploration Colloquium c/o Dr. E. R. Van Driest, Director Aero-Space Laboratories, Missile Division North American Aviation, Inc., 12214 Lakewood Boulevard, Downey, California.*

DEAR DOCTOR MOORE:

Your letter with a form for the 1960 National Science Register, addressed to my son, Barry C. Bishop, 4100 W Street, N.W., Washington 7, D. C., has been forwarded to him in my care at the address below.

Barry is with The Himalayan Scientific and Mountaineering Expedition in Nepal, which is under the leadership of Sir Edmund Hillary. The expedition expects to be in Nepal for several months, therefore, I think it best to inform you of this fact, keep the form for him so that he can follow it up when he returns.

Sincerely yours,

ROBERT W. BISHOP
Dean, Summer School
University of Cincinnati

DEAR EDITOR:

I am most grateful to you for inserting my letter in the September issue of GEOTIMES. I have already had an airmail response from Professor Buie of Florida State University offering one of the missing numbers. I hope that other offers may come to light but even if this is not the case we shall at least have completed one more volume for our set, and the insertion of the letter has been very well worth while.

May I thank you again on behalf of the department for your assistance in this matter.

Yours sincerely,

H. B. S. COOKE
Univ. of Witwatersrand
Johannesburg

SIR:

In his letter on page 28 of the October 1960 GEOTIMES about a map symbol for Paleocene, Maurice Kamen-Kaye says, "the Paleocene, by its very name, is Eocene more than it is anything else." Perhaps he thinks this statement is true because he has often heard the term "Paleocene" improperly pronounced "Pal-eocene," as though it were derived from "Pal" and "Eocene." Actually the term "Paleocene" has nothing whatever to do with the term "Eocene." It is derived from two distinct Greek roots, *paleo* from *palaios*, ancient, old, and *kainos*, new, recent. The *cene* here is the same termination as in the names of all the other Cenozoic epochs. Literally, therefore, the term "Paleocene" means ancient or old recent; "Eocene," from *eos*, dawn, and *cene*, recent, means dawn of the recent; and so on for the rest of the epochs. Consequently, the term "Paleocene" should be pronounced "Paleocene," as though it were spelled "Pallioseen," with the "a" short as in "rat," not long as in "race." Similarly, the "a" should be pronounced short wherever else the root *paleo* occurs, as in Paleozoic, paleontology, paleobotany, paleolithic, etc.

Unfortunately for clarity of meaning, by neglecting etymology many speakers mispronounce other geologic terms, as "O-lig-o-cene" for "Oligo-cene," "la-brad-o-rite" for "labrador-ite," and "a-rag-o-nite" for "aragon-ite." Such slovenly pronunciation conveys a distortion of meaning to the sensitive listener and helps to perpetuate error as exemplified by the foregoing discussion of the term "Paleocene." Additional illustrations of the relationship between etymology, spelling, pronunciation, and meaning, may be found on page 60 of my book, "Composition of scientific words," 1956.

Yours truly,

ROLAND W. BROWN
Lehighton, R. 3, Pa.

DEAR EDITOR,

It may make no difference to most readers whether you have

И ШОХОЙРГ
or
И ПОХОДЫ...

It is observed that a "campaign" which is inverted might be construed as depicting a retreat and no matter how tough things were *(GeoTimes, Vol. V, No. 4, p. 32-33)* my geological comrades were not about to retreat.

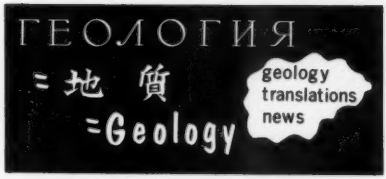
Yours for greater accuracy,

A. G. *"Red"* OLOGIST

DEAR SIR:

Great contributions have been made in the last year in the realm of evolutionary thinking, and many fine volumes have been published on Darwinian rationality. But we perceive, however, that we are not adequately familiar with the literature of systematics, and therefore have attempted (most likely in vain) to elucidate the most important of all taxonomic problems, viz.: *"The Type Concept in Paleontology."*

What follows will no doubt read like a list, but, in reality, it is the paleontological



Do the Russians place greater emphasis on monographs as media of scientific reporting than we?

Should we translate a few papers from many foreign publications or should we select the few best foreign journals and translate them cover-to-cover?

Is the most effective coverage of the foreign literature of our science to be obtained by specialists cooperating voluntarily or should we contract for literature screening, as well as translation, from commercial firms?

How can we best convince our scientists that they must not neglect foreign research?

These are a sampling of the questions considered by scores of geologists at various meetings held in conjunction with the convention of the Geological Society of America, Denver October 29-November 3. Participants of a symposium of the National Association of Geology Teachers attacked the problems at the university level. Speakers A. V. Carozzi, D. B. Vitaliano, and R. K. DeFord emphasized that by far the most effective means of following and utilizing foreign research is to read the work in the original language and be able to converse with foreign geologists without the need for interpreters. Recognizing that this is an ideal ambitiously to be sought but not immediately, if ever, attainable, efforts to publish the results of foreign research in English translation were encouraged.

Hawkes Heads
AGI Translations Committee

Professor Herbert E. Hawkes, Department of Mineral Technology, University of California, Berkeley, has recently been named by AGI President Ian Campbell as Chairman of the AGI Advisory Committee on Translations. Dr. Hawkes succeeds Professor Earl Ingerson of the University of Texas who has served in that capacity since March 1959.

The Board of Editors of International Geology Review met to review old policies and formulate new ones governing the selection, translation and publication of this journal devoted to the literature of geology in foreign languages. The need for covering longer works by means of condensation and informative review was emphasized.

The Advisory Committee on Translations of the American Geological Institute, under the chairmanship of Earl Ingerson, met for nearly ten hours to consider the translation needs of geologists and recommend the best ways to fulfill them. Paul Feinstein represented the National Science Foundation whose encouragement and assistance has made possible much of what has been accomplished in the field of geologic translation to date. Perhaps the strongest recommendation made by the committee was that the various disciplines of geology should, through the appointment of delegates or committees of societies, take the responsibility for covering the foreign literature in their fields and provide existing translation services with the information needed to provide a balanced coverage for the entire field of geology.

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rationale developed in accordance with the *International Rules of Nomenclature*, and thoroughly discussed at our graduate coffee seminars.

We beg to present for your judgment and consideration the results of our endless labors in the form of the following:

CATALOGUE OF TYPES

SYNONOTYPE—holotype of synonym.
METROTYPE—measured type.
DISSECTOTYPE—dissected type.
THINSECTOTYPE—thin-sectioned type.
SOLUTYPE—type treated with acid.
FRAGMOTYPE—stepped-on holotype.
CONSTRUCTOTYPE—type of badly wanted specimen.
LIMBOTYPE—lost type specimen.
INCOGNITOTYPE—type with label lost.
AMBIGUOTYPE—mislabelled type.
HOAXOTYPE—planted type.
KLEPTOTYPE—stolen and described type.
BOOBOTYPE—type which should not have been described.
REMORSOTYPE—type author regrets having described.
COLLECTOTYPE—collected type.
NONCOLLECTOTYPE—uncollected type.
CRYTOTYPE—holotype described in *Turtox News*.

Respectfully yours,

LITHODORE DETRITUS, cf.Ph.D.
Curator, Academy of Paleontological Lost Arts and Sciences.

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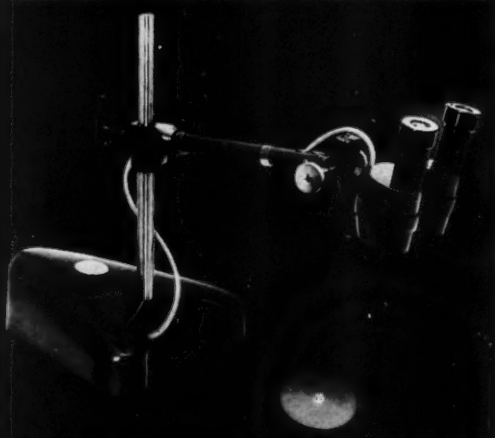

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GEOLOGIC MAP OF PENNSYLVANIA, 1960 *Edition, Pennsylvania Topographic & Geologic Survey, 1:250,000 in two 42" x 58" sheets, full-color, order folded or in roll from Commonwealth of Pennsylvania, Division of Documents, 10th and Market Sts., Harrisburg, Pa. $3.75.*

This new state map is based on much new mapping and has been compiled on recent topographic maps.

GEOLOGY OF THE PARADOX BASIN FOLD AND FAULT BELT, *Four Corners Geological Society, 1960 Field Conference Guidebook, edited by Kenneth G. Smith, 173 pp., Four Corners Geological Society, Box 1501, Durango, Colorado.*

This publication contains 26 papers on the complex geology of the Paradox Basin Salt anticline—Uncompahgre Uplift Area which is currently undergoing extensive exploration following discovery of the Northwest Lisbon oil and gas field.

The book is thoroughly and clearly illustrated with maps, charts, cross-sections, and many excellent photographs. It contains detailed road logs covering the Salt anticlines, Uncompahgre Uplift, and the La Sal Mountains.

GLOSSARY OF GEOLOGY AND RELATED SCIENCES: WITH SUPPLEMENT, *2nd Edition, J. V. Howell and J. Marvin Weller (supplement), 397 pp., 1960, casebound, American Geological Institute, 2101 Constitution Ave., N.W. Washington 25, D.C. $7.50.*

Original 1957 edition has been keyed to refer to nearly 4000 new and redefined terms appearing in supplement which is bound in book as part two. The keying to the supplemental terms is a valuable feature of this new volume.

GEOLOGIC EVOLUTION OF EUROPE, *by R. Brinkmann, translated to English by John E. Sanders, 161 pp., 1960, Hafner Publishing Co., 31 E. 10th St., New York 3, N.Y. $8.50.*

The geologist seeking an over-all view of the classical geology of Europe will find this book extremely worthwhile. The author, Professor Roland Brinkmann, is to be in the United States this Spring under auspices of the AGI Visiting International Scientist Program.

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"THE MAKING OF THE BROADS", *J. M. Lambert et al., Royal Geographical Society, London, 1960, 153 pp., illus., 25 shillings.*

This work fills a need in an interdisciplinary field of which all too many geologists are ignorant. Assuredly it could never have been written in the United States. The authors demonstrate how original natural processes have been modified by man over a period of some seven centuries. Refined techniques of dating are introduced, and critical features of beds clearly illustrated.

Though technical in detail, this book will prove particularly edifying to the lay reader.—R.G.

PETROLEUM DEVELOPMENTS AND GENERALIZED GEOLOGY OF AFRICA AND MIDDLE EAST, *by A. H. Munger, E. Placidi, et al., 1960, 115 pages of base maps with 60 pages of geological overlays, size 11 x 18, A. H. Munger, 5865 West Blvd., Los Angeles 43, Calif. $40.00.*

Geological compilations of this publication are done by Edward A. Gribi, Jr. Contains information test wells and oil company holdings.

GEOTIMES INDEX TO VOLS. I-IV, *37 pp., 1960, compiled by Kathryn Lohman, American Geological Institute, 2101 Constitution Ave., N. W., Washington 25, D. C. $1.00.*

A complete subject matter—author index to the first four volumes of GeoTimes.

GEOLOGICAL SURVEY RESEARCH 1960, SYNOPSIS OF GEOLOGIC RESULTS, *Prof. Paper 400-A, 136 pp., 1960, U. S. Gov't. Printing Office, Washington 25, D. C., $1.00.*

This report summarizes recent advances in the broad spectrum of research by the Geologic Division of the Geological Survey during fiscal year 1960. This report is a new service of the U.S.G.S. to inform the using-public of the progress of the organization's research program.

GEOLOGICAL SURVEY RESEARCH 1960, SHORT PAPERS IN THE GEOLOGICAL SCIENCES, *Prof. Paper 400-B, 515 pp., 1960, U. S. Gov't. Printing Office, Washington 25, D. C., $4.25.*

A companion volume to 400-A (above) which contains 232 separate short papers by individual research workers summarizing significant research contributions made in fiscal year 1960.

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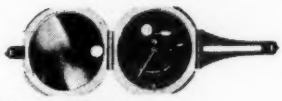

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GEOLOGY OF INDIA AND BURMA, *Fourth Edition, by M. S. Krishnan, 604 pp., 1960, Higginbothams, Ltd., Mount Road, Madras 2, price Rs. 22.50.*

Geologists looking to 1964 and the XXII International Geological Congress in India will be interested in this most recent edition of Dr. Krishnan's book for general reference and for the over-all background it provides in understanding the geology of India.

AN INTERNATIONAL DIRECTORY OF OCEANOGRAPHERS, *3rd Edition 1960, compiled by K. O. Emery and Mary Sears, 177 pp., 1960, NAS-NRC, request from Richard C. Vetter, Committee on Oceanography, National Academy of Sciences–National Research Council, 2101 Constitution Ave., N. W., Washington 25, D. C.*

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BOX 768. GEOLOGIST-MINERALOGIST, Ph.D., 31, family. Three years experience in major oil company research laboratory in fields of X-ray and fluorescence analysis, clay mineralogy and geochemistry of sediments. Broad graduate background in geology. Desires position at college or university. Available immediately.

BOX 769. PETROLEUM GEOLOGIST-STRATIGRAPHER, 33, M.S., family, 8 years varied experience in teaching, exploration, research and consulting, Texas, Mid-Cont., Appalachians & Rockies. Desire a responsible position in exploration or basin studies. Have supervisory experience. Will consider any position. Resume sent upon request.

BOX 774. GROUND WATER GEOLOGIST-HYDROLOGIST, 40, family. 1 year post graduate work. Five years experience with USGS, five years consulting. Geohydrology and engineering background with experience throughout U. S. Interested in position of responsibility. Open to foreign work. Resume on request.

BOX 776. PALEONTOLOGIST-STRATIGRAPHER, 40, M.S., Ph.D. expected '61. Desires teaching position with opportunity for research. 14 yrs. college teaching experience in paleontology, stratigraphy, sedimentology, historical, physical and petroleum geology and related fields. Experience includes state survey work. Publications.

BOX 781. Ph.D. 1956. Four years full-time teaching and research; varied Canadian field experience. Interests in metamorphic geology and geochemistry, structural geology. Seeks academic position commencing September 1961.

BOX 783. PROFESSOR, Ph.D., phys. and econ. geology, sedimentology, oceanography, petrology; 14 yrs. exp. Desires grad, and undergrad. teaching.

BOX 784. ECONOMIC GEOLOGIST, Ph.D., 31, small family. Seven-year period background in metals, nonmetals (inc. petroleum) and mineral economics. Industrial, academic and survey experience together with publications. Field work in U.S. and Canada. Desires responsible position with organization having diversified interests and operations; location optional. Salary open. Presently employed, resume and references on request.

POSITIONS WANTED—Continued

BOX 785. MINING GEOLOGIST, 10 years varied experience in western U.S., central Africa. Specialty in metalliferous deposits, some knowledge in non-metallics. Graduate, Missouri School of Mines. Advanced study, Univ. of Colorado. Seek staff position requiring vigorous field activity, supervisory responsibility. Currently in basic research. Any area having schools.

BOX 786. GEOLOGIST, nine years experience in the Four Corners, Panhandle and West Texas. Broad exploratory background includes sub-surface, administration and seismograph. Some field and well work. Desires more responsibility.

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BOX 788. TEACHING. Structural geologist with interest in economic and allied fields and 15 years experience in teaching, industry, and government wants position at college or university.

BOX 789. GEOLOGIST, Ph.D. (1952) desires teaching position; morphological and optical crystallography, mineralogy, petrology, petrography and/or structural, regional, and historical geology. Over ten years teaching experience, mainly in large institutions; small or medium-sized college preferred.

BOX 790. ECONOMIC GEOLOGIST with engineering geology experience. Would like university position in strong Geology Department. Ph.D. with thirteen years international experience. Available in Sept.

BOX 791. GEOLOGIST, Ph.D., 33, 6 years mineral exploration; several publications; several languages; desires research and/or teaching position.

BOX 792. GEOLOGIST, 25, single, European education, fluent English, French, German, Dutch. 2½ yrs. Canadian experience government surveys, copper-and asbestos exploration. Excellent references, resume on request. Main interests: structural geology, petrology. Desires seasonal or permanent employment with Canadian company or survey. Opportunity for research toward Ph.D. thesis appreciated. Available for interview and appointment May 1961.

BOX 793. GEOLOGIST-GEOPHYSICIST, 31, Ph.D. geology, M.S. physics, desires industrial or teaching position with research opportunities, preferably in Western U. S. or Canada. Qualifications include research and field experience in exploration geophysics, ore deposits, igneous and metamorphic petrology, and structural geology; two years as electronics technician; some teaching experience in geology, physics, methematics. Recently completed N.S.F. research followship in volcanology. Currently geologist for university Antarctic expedition; available June 1961.

BOX 794. MINING GEOLOGIST-PETROLOGIST, M.S. in Mining Geology. Age 28. Married, family. Experienced in X-Ray, D.T.A., and petrographic techniques. 3 yrs. with major company. Desires teaching or research position with University in Western U. S. offering Ph.D. program in geology. Will consider any type financial aid.

BOX 795. ASSISTANT PROFESSOR, 34, Ph.D. 7 yrs. teaching experience, 2 yrs. major oil company, desires to relocate. Main fields are invertebrate paleontology, sedimentology, stratigraphy, and structural geology. Has also taught petrology, optical mineralogy, and field geology. Summers have been spent mapping for a state survey. Resume on request.

BOX 796. ASST. PROF. Ph.D. Isolated State University wishes to teach in college or university in more desirable locale. Active researcher, Member professional societies, Bilingual, 5 yrs. varied governmental and industrial experience, 4 years teaching experience. Resume on request.

BOX 797. PETROLEUM GEOLOGIST, B.Sc., 33, family, 10 yrs. experience with major oil company as land surveyor and subsurface geologist. Geological experience mainly in Rocky Mountains and Western Canada. Desires employment as exploration or exploitation geologist in Rocky Mountains. Resume on request.

BOX 798. EXPLORATION GEOLOGIST, B.A. (W.V.U.), M.S. (U.N.M.), 35, family desires to relocate in W. Va., Ohio, Ky., Penn., or Va. area. 8 yrs. experience (research, field work, subsurface, well sitting, etc.) with U.S.G.S. (Fuels Br.) and Major Gas Co. in S.W. Desires position as geologist or teacher (science and/or geology) in secondary school or small college. Teaching experience in Air Force. Mbr. AAPG & Sigma Xi.

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GEOLOGIST, Ph.D., 27, family, desires teaching position, special fields: sedimentology, structural geology; thorough background in physical sciences; research and field experience in physics and geology; 6 yrs. teaching experience; special ability in teaching elementary undergraduate subjects. Write R.F.D. 4, Box 164, Middleboro, Mass.

BOX 801. MINING-EXPLORATION GEOLOGIST, M.A., 28, single. Presently completing a two year developmental project connected with a large ore deposit in West Africa. Previous geological position in the southwestern states. Desires to continue career in Africa.

BOX 802. WOMAN GEOLOGIST seeks office geology or library research. 14 years experience in U.S., Newfoundland and Africa includes bush prospecting, report writing and general assistance at corporation head offices.

BOX 803. RESEARCH GEOLOGIST, 31, 5 years industrial, teaching, research, consulting experience. Publications (stratigraphy, economic, structure, sedimentation) attest to drive, ambition, optimistic thought pattern necessary to recognize, organize, and successfully complete diverse assignments. Desire association doing basic research/evaluation on any level, i.e., industrial, survey, academic. Salary of least concern. Presently employed.

BOX 804. GEOLOGIST Single, 28, trilingual, M.Sc., leaning towards geophysics, working in oceanography and electronics, would like to be placed in field exploration. No limitations on travel.

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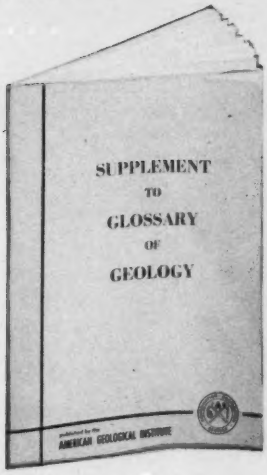

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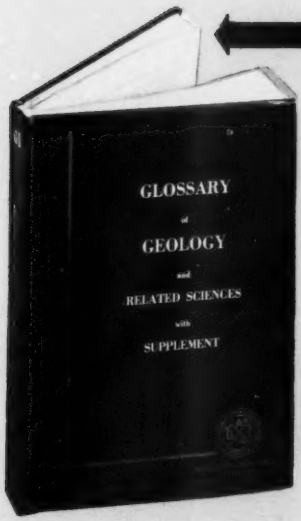

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